AD A

EPA Emission/Low Sulfur Impact on Military Generator Sets

INTERIM REPORT
TFLRF No. 355

by

D. M. Yost
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Under Contract to

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Using high-sulfur and low-sulfur fuels 200-hour evaluations were completed. An examination of the injection pump componenets indicate that low-sulfur fuel operation should provide adequate durability. There was slightly more polishing with the low-sulfur fuel, but all performance characteristics were met at the end of testing.

In conjunction with an ongoing fuels survey at various military installations, a survey of generator set maintenance changes since the switch to low-sulfur diesel fuel was performed. The impact of the low-sulfur fuel on the readiness of older equipment should be reflected in the variation of the maintenance levels. No increases in generator set component usage had been reported since the switch to low-sulfur diesel fuel or JP-8.

The regional administrators of the ten EPA regions were contacted, and the points of contact for all 50 states for non-road emissions were attained. The majority of states will utilize the EPA guidelines for non-road emissions.

14. SUBJECT TERMS

EPA	Injector	High-Sulfur Diesel Fuel
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Non-road	Generator	Unit Pump

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EXECUTIVE SUMMARY

An analysis of the fuel injection system components for the Tactical Quiet Generator (TQG) sets was completed to determine the critical parts for inclusion in a fuel lubricity investigation. The investigation determined the impact of various fuels on fuel injection system wear. An injection system bench test stand was utilized for accumulating hours on the fuel-wetted injection system components using the various lubricity fuels. The component wear was evaluated to determine the relative wear of the fuel injection system barrel and plunger components with each fuel.

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FOREWORD/ACKNOWLEDGMENTS

This work was performed by the U. S. Army TARDEC Fuels and Lubricants Research Facility (TFLRF) located at Southwest Research Institute (SwRI), San Antonio, Texas, during the period June 1994 through October 1999 under Contract No. DAAK70-92-C-0059. The work was funded and administered by the U. S. Army Tank-Automotive RD&E Center, Petroleum and Water Business Area, Warren, Michigan with Mr. Luis Villahermosa (AMSTA TR-D/210) serving as the TARDEC contracting officer's representative and project technical monitor.

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LIST OF ACRONYMS

ARB	Air Resources Board
CAT1H	0.4-percent sulfur reference fuel
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
ISO	International Organization for Standardization
kW	kilowatt
LSRD4	0.05-percent low-sulfur reference fuel
MEP	Mobile Electric Power
PM	Program Manager
PLN	Pump Line Nozzle
PPM	Parts Per Million
RPM	Revolutions per Minute
TQG	Tactical Quiet Generator

I. BACKGROUND

The use of EPA-mandated 0.05-percent low-sulfur diesel fuel in on-highway diesel engines has resulted in reliability concerns due to fuel lubricity and elastomer compatibility. Certain areas of the country that used winter diesel fuel did have fuel lubricity issues, but the widespread concern did not materialize until the nationwide adoption of low-sulfur diesel fuel. Mandated use of low-sulfur fuel meant hydrotreating in the refineries to remove sulfur, which also resulted in removal of the trace amounts of organic acids beneficial to fuel lubricity. (1)* Pending regulations, which may extend the use of low-sulfur fuel to off-road vehicles and equipment, may impact military generator set readiness.

II. OBJECTIVE/APPROACH

To understand these impacts, a program was initially outlined to evaluate a representative older, fielded generator set on low-sulfur fuel to determine any impacts due to fuel switching. Another phase of the program will determine the impact of switching between high- and low-sulfur fuels for newly designed/fielded equipment. A final phase of this program will monitor the pending emission regulations as they pertain to off-road equipment.

The Program Manager-Mobile Electric Power (PM-MEP) Office determined that bench testing of various fuel-injection system components would be adequate in lieu of testing the generator sets to determine the low-sulfur fuel impact on military generator sets. The program tasks outlined below reflected the PM-MEP concerns with regard to low-sulfur fuel and off-road/non-road exhaust emissions:

- Task 1: To evaluate the durability of 5- and 10-kW tactical quiet generator set fuel-injection system components with low-sulfur fuel.
- Task 2: To evaluate older generator sets preconditioned with higher-sulfur fuel and to determine the effects that utilizing low-sulfur fuel has on fuel system components.

***Numbers underscored in parentheses indicate references at the end of the document.**

Task 3: To develop a database of emission-regulating authorities and their requirements as they pertain to generator sets and to review emission test procedures.

III. DISCUSSION

A. Task 1

An analysis of the fuel-injection system components for the Tactical Quiet Generator (TQG) sets was performed to determine the critical parts for inclusion in the fuel lubricity investigation. The investigation determined the impact of various fuels such as 0.05-percent sulfur DF-2 and 0.4-percent sulfur DF-2 on fuel-injection system wear. An injection system bench test stand was utilized for accumulating hours on the fuel-wetted injection system components using the various lubricity fuels. The component wear was evaluated to determine the relative wear of the components with each fuel.

The TQG sets are available in 5-kW and 10-kW ratings. The 5-kW set utilizes a 3-cylinder, 4-cycle diesel engine. The 10-kW set utilizes a 4-cylinder, 4-cycle diesel engine, of the same engine family as the 5-kW unit. Each TQG engine has a Pump-Line-Nozzle (PLN) fuel-injection system, with a crankcase mounted unit pump for each cylinder. The unit pumps contain a barrel and plunger, which are considered the critical components for wear in the fuel-injection system.

The unit pump (barrel and plunger included) and the injector from the TQG engines were evaluated utilizing a fabricated test fixture. The test fixture also utilized a portion of the engine camshaft, which contained the injection lobe. The roller follower and follower cup were also utilized to complete the assembly of the test injection rig. A diagram of the injection rig is shown in Figure 1. A copy of Army TM 9-2815-253-24 was attained to ensure utilization of proper procedures and adjustments when the components were assembled. The positioning of the injection pump relative to the camshaft was determined to ensure that the correct injection stroke was utilized. The test rig was capable of altering injection pump rack position and controlling unit pump fuel inlet temperatures.

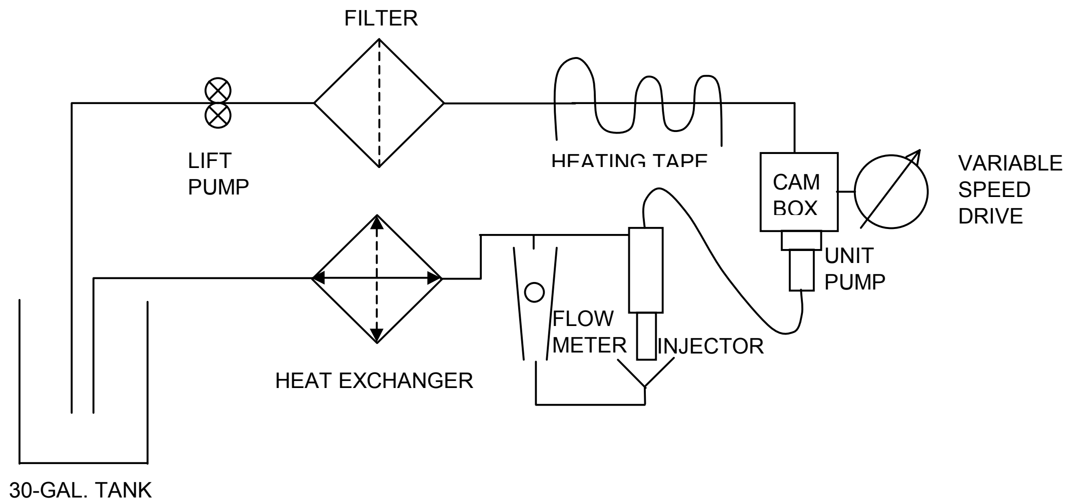

Figure 1. Injection Rig Schematic

The test conditions chosen for the component evaluations are shown in Table 1. The TQG sets operate at 3600-RPM synchronous speed, thus the unit fuel-injection pump drive speed was 1800 RPM. The duration and fuel inlet temperature was chosen to be comparable with historic test data on rotary type fuel-injection pumps. The fuel tank temperature was chosen to keep the test fuel below the flash point. The fuel flow setting was chosen based on the calculation of fuel required/cylinder to meet the maximum generator rating, plus additional fuel to increase the loads on the components. It was noted that the unit pumps had a substantially higher maximum fuel output than the TQG required for achieving its kW rating. A rack position stop was set up to hold the position constant during testing. It was anticipated that with a constant rack position, wear in the system would result in lower injected fuel flows. The test fuel was continuously circulated throughout the testing, thus a 30-gallon fuel reservoir was chosen to ensure that fuel lubricity did not change during testing.

An evaluation was performed utilizing a 0.05-percent low-sulfur reference fuel (LSRD4), a fuel utilized to perform various lubricant qualification tests for diesel engines. The high-sulfur fuel for comparison was a 0.4-percent sulfur reference fuel (CAT1H) that was the high-sulfur lubricant qualification test fuel replaced by LSRD4. Prior to testing with each fuel, the injector opening pressure was evaluated.

Table 1. Pump Rig Operating Conditions	
Parameter	**Setting**
Speed, RPM	1800 ±5
Fuel Flow, pph	6
Rack Setting, inches	0.330
Duration, Hours	200
Fuel Inlet Temperature, °F	170 ±5
Fuel Tank Temperature, °F	<100

Comparisons of the fuel tank and fuel inlet temperatures are shown in Figure 2 for both fuel evaluations. The fuel inlet temperature was consistently held within the target range for both fuel evaluations. It should be noted that the 170°F fuel inlet temperature is on the high end of fuel inlet temperatures expected on a 125°F day. The difference in fuel tank temperatures reflects the months the tests were run, but both are well below 100°F.

The fuel flow readings for the two fuel evaluations are shown in Figure 3. The plot for the LSRD4 fuel flow shows variations in the injected fuel flow rate. The LSRD4 was the first evaluation, and several reliability and set up issues with the pump rig surfaced during the initial stages of testing. Sometime between 6 and 20 hours, the pump drive coupling became worn and induced considerable backlash in the drive. The coupling component was replaced, during which time the unit pump was removed to inspect the cam and roller in the cam box for proper lubrication. When the unit pump was installed, the operator inadvertently indexed the unit pump and rack engaging fork toward full-rack; this is reflected in the high fuel flow. It can also be seen that the indexing was not quite correct at about 25 hours; this time the fork engaged the rack toward the idle position. Efforts were made to ensure that proper alignment marks were made on each component so that they could be installed consistently.

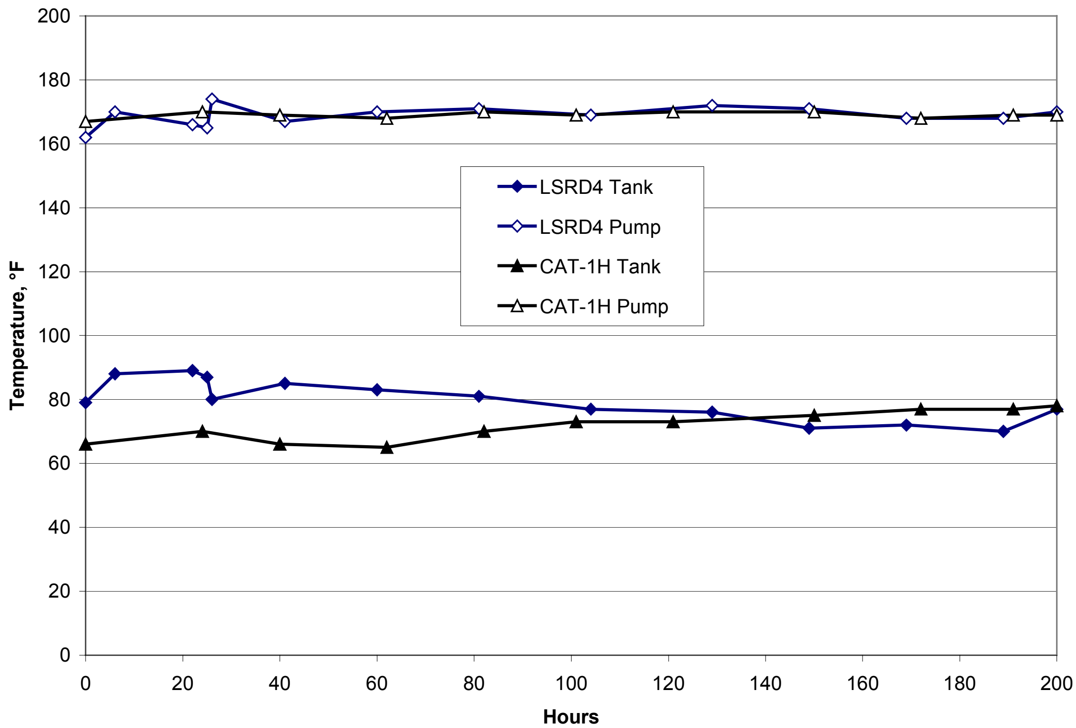

Figure 2. Fuel Tank and Injection Pump Temperatures

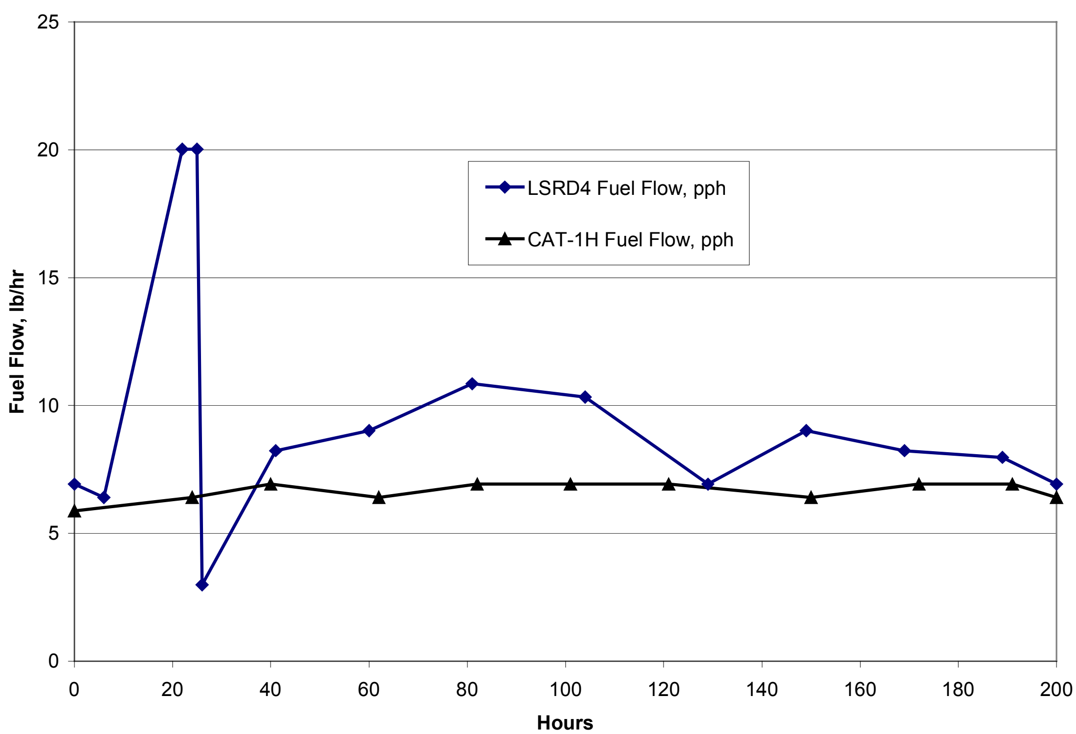

Figure 3. Injected Mass Fuel Flow Rate

At 26 hours with LSRD4, the pump coupling sheared the drive key. It was determined that the key was too small for the keyway. The backlash induced by the small key probably contributed to the earlier coupling element failure. The shaft and coupling were repaired, along with an improvement on the lubricant flow into the thrust-bearing surface for the camshaft.

The low-sulfur fuel screening successfully completed 200 hours. Other operational problems were due to a worn drive-coupling element and a failed lift pump. The drive coupling material was not compatible with the shock loading requirements of the unit fuel-injection pump. The backlash due to the worn element caused a relief of injection pressure back into the inlet port, which eventually lead to a rupture of the fuel inlet hose. The wear in the coupling was not attributable to the low-sulfur fuel.

Based on fuel flow, the LSRD4 evaluation was performed at an overall higher load than the CAT1H evaluation. Teething problems with the fabricated test pump fixture during the LSRD4 evaluation probably also increased the severity of testing for the low-sulfur fuel.

A 200-hour evaluation using high-sulfur fuel was completed and the results compared to the low-sulfur evaluation. Injector inspections for the fuel evaluations are shown in Table 2. The results indicate a degradation in injector performance due to the low-sulfur fuel.

Table 2. Injector Performance Inspections

Parameter	Specification	LSRD4		CAT1H	
		Before Test	After Test	Before Test	After Test
Nozzle Opening Pressure, psi	3552-3697 (New and Service)	3550	3300	3600	3500
Chatter		Excellent	Good	Excellent	Excellent
Spray Pattern		Excellent	Excellent	Excellent	Excellent

Interestingly, the new injector for the LSRD4 evaluation was at the bottom end of the manufacturer's opening pressure specification. Also, the CAT1H fuel resulted in an after-test nozzle opening pressure slightly below the specification. The spray and chatter are subjective ratings of the spray pattern and injector sound determined when the injectors are tested for opening pressure.

Subjective ratings of the unit pump plunger and delivery valve for the evaluations are shown in Table 3. The subjective wear is based on 10 being a failure, which in the case of the plunger would be a seizure. The additional wear noted by the rater for the low-sulfur fuel was primarily a larger area of polishing. Some of the wear on the components can be attributed to the fuel, but the overall more severe evaluation with LSRD4 clouds the issue.

Table 3. Unit Pump Subjective Wear Ratings

	LSRD4	CAT1H
Plunger	6	2
Delivery Valve	4	2
Subjective Rating: 0=no wear; 10=Failure		

An examination of the fuel-injection pump components indicates that low-sulfur fuel operation should provide adequate durability. There was more polishing with the low-sulfur fuel, but the fuel-injection quantities were met at the end of testing with the preset rack position.

B. TASK 2

In conjunction with an ongoing fuels survey at various military installations, generator set maintenance changes were also surveyed since the switch to low-sulfur diesel fuel was performed. The impact of the low-sulfur fuel on the readiness of older equipment should be reflected in the variation of the maintenance levels. There were no increases in generator set component usage with the switch to low-sulfur diesel fuel reported by the survey participants.

The regulation of low-sulfur diesel fuel for on-road use coincidentally corresponded with a switch by the Army to utilize JP-8 in all assets. The utilization of JP-8 meant low-sulfur diesel fuel was not used in many generator sets.

A visit was made to Malmstrom Air Force Base, MT, on a fuels-lubricity issue. The maintenance personnel were interviewed on issues concerning generator set maintenance. Malmstrom Air Force Base has been utilizing a low-lubricity diesel fuel, which base personnel have been treating with 345-ppm corrosion inhibitor to improve lubricity. Personnel interviewed indicated that generator set maintenance levels were normal and had not increased due to low-lubricity fuel.

A demonstration program was performed at Ft. Bliss, TX, where the post was converted to JP-8 fuel. (2,3) Although JP-8 is not technically a low-sulfur diesel fuel (the specification allows up to 0.3-percent sulfur) 75 percent of the 1994 delivered volume of JP-8 met the low-sulfur fuel requirement of 0.05-percent sulfur.(4) JP-8 is recognized as having lower lubricity than diesel fuel, partially attributed to lower viscosity. Part of the Ft. Bliss demonstration program was to track fuel-wetted component usage, including generator sets, when the post was switched to JP-8. There was no statistically significant change in fuel-wetted component usage after JP-8 conversion. (2)

The 3rd Corps 57th Signal Brigade at Ft. Hood, TX, was visited to determine any increase in generator set fuel injection component usage from switching to JP-8. Unit maintenance personnel indicated that generator sets, which historically had fuel system problems and those that were reliable, had not changed with the use of JP-8. Personnel did not have records to indicate if component usage changed with the fuel switch to JP-8.

C. Task 3

The EPA exempts nonroad compression-ignition engines from emission standards. Nonroad engines and equipment are exempted in accordance with 40 Code of Federal Regulations (CFR), Subpart J, Section 89.908, Control of Emission from New and In-Use Nonroad

Compression-Ignition Engines, National Security Exemption (Appendix A). But it was not clear if any states and their non-attainment zones have any regulations pending or future emissions and/or permit regulations. The Army has a wide range of diesel MEP, generators ranging from 3 kW (4.0 hp) to 750 kW (1,006 hp) using low-sulfur diesel fuel and JP-8 fuels. These MEP generators are hand-portable, pick-up portable, skid-portable, trailer-mounted, and truck-mounted and provide MEP for tool equipment, tents, command posts, weapons systems, emergency power, etc. Therefore, the EPA administrators of all ten regions, all 50 states and their non-attainment zones, D.C., and four territories were contacted to obtain their pending and future emissions and permit regulations for the various size diesel engines using low-sulfur diesel and JP-8 fuels that power non-road Army MEP generators used in the United States. All responded except Puerto Rico and the Virgin Islands from Region 2 and American Samoa, Guam, and Hawaii from Region 9. These states and territories were contacted several times by telephone and letter, with no return response.

Naturally aspirated non-road engines will not be allowed to discharge crankcase emissions (blowby) to the atmosphere. For engines under 37 kW, this restriction applies to model year 2001 and later. For engines 37 kW or larger, the restriction applies to Tier 2 engines and later models.

Those states having exemptions from regulations or getting a permit can be seen in Table 4. More detailed information and contacts are included in Appendix B. These regulations are as of September 1, 1996. A total of 55 agencies were contacted; of those, 28 had no regulations, 22 had a limit as to when regulations apply or a permit is necessary, and 5 did not respond to our repeated inquiries.

Table 4. Mobile Electric Power Generators	
NO REGULATIONS OR EXEMPT	
REGION 1 • **Connecticut** (if less than 100 tons/yr of any pollutant) • **Massachusetts** (if energy input capacity is less than 10,000,000 BTU/hr) • **Maine** • **New Hampshire** • **Rhode Island** • **Vermont**	**REGION 6** • **Arkansas** • **Louisiana** (over 500 hp operates for less than 30 days/quarter) • **New Mexico** (if less than 100 tons/yr of any contaminant or during field exercises) • **Oklahoma** • **Texas**
REGION 2 • **New Jersey** (if less than 100 tons/yr carbon monoxide) • **New York** (emergency equipment that operates less than 500 hrs/yr and less than 1000 BHP) • **Puerto Rico** (no response) • **Virgin Islands** (no response)	**REGION 7** • **Iowa** • **Kansas** • **Missouri** (if less than 100 tons/yr of any pollutant) • **Nebraska**
REGION 3 • **Delaware** (if under 10,000,000 BTU/hr) • **Washington, D.C.** • **Maryland** • **Pennsylvania** (if not fixed for less than 30 days) • **Virginia** (if operates under 500 hrs/yr) • **West Virginia**	**REGION 8** • **Colorado** • **Montana** (if less than 25 tons/yr of any pollutant) • **North Dakota** • **South Dakota** • **Utah** • **Wyoming** (when less than 500 hrs/yr)
REGION 4 • **Alabama** • **Florida** • **Georgia** • **Kentucky** (less than 5 tons/yr of any pollutant) • **Mississippi** • **North Carolina** (less than 5 tons/yr of any pollutant) • **South Carolina** (if less than 150 kW or operates for less than 250 hrs/yr) • **Tennessee**	**REGION 9** • **Arizona** (less than 40% opacity for 10 sec. and over 500 kW needs a Class II permit) • **California** • **Hawaii** (no response) • **Nevada** • **American Samoa** (no response) • **Guam** (no response)
REGION 5 • **Illinois** • **Indiana** • **Michigan** (less than 20,000,000 BTU/hr heat input capacity) • **Minnesota** • **Ohio** (less than 50 hp; over 50 hp, less than 500 hrs/yr operation) • **Wisconsin** (less than 80% opacity)	**REGION 10** • **Alaska** • **Idaho** (less than 100 tons/yr of any contaminant) • **Oregon** (less than 500 hrs operation/year) • **Washington** (less than 100 tons/yr carbon monoxide)

The EPA has adopted off/non-road emission standards for new manufactured engines. The EPA's original timetable for its implementation and proposed regulations can be seen in Tables 5 and 6. So many of the new MEP generators purchased by the military will probably meet the EPA requirement even though they are exempt. California's regulations now conform to the EPA, which reads "on-road motor vehicles and off/non-road or equipment owned by the U.S. Department of Defense and/or the U.S. military services, and are used in combat, combat service support, tactical or relief operations, or training for such operations are excluded and exempt from exhaust emission standards." Other agencies will probably follow California's lead. If not, many of the new MEP generator engines will still meet the new EPA manufacturer regulations. As of September 1, 1996, no states or their non-attainable zones reported any immediate regulation changes for military non-road diesel MEP generators.

Table 5. EPA's Implementation Timetable for New Off/Non-Road Diesel Engines

Engine Size (kW (hp)	Implementation Date
≥ 130 (175) to ≤ 560 (750)	January 1, 1996
≥ 75 (100) to ≤ 130 (175)	January 1, 1997
≥ 37 (50) to ≤ 75 (100)	January 1, 1998
> 560 (750)	January 1, 2000

Table 6. EPA Off/Non-Road Emissions Standards for New CI Engines

New Power kW (hp)	HC G/kW-hr	CO g/kW-hr	NO_x g/kW-hr	PM g/kW-hr	Smoke Percent A / L / P
130 (175)	1.3	11.4	9.2	0.54	20 / 15 / 50
≥ 75 (100) to < 130 (175)	--		9.2	--	20 / 15 / 50
≥ 37 (50) to < 75 (100)	--		9.2	--	20 / 15 / 50

The 23 October 1998 Federal Register published the final rule for Control of Emissions of Air Pollution from Non-road Diesel Engines, 40 CFR Part 9, et al. The emission standards are in units of g/kW-hr utilizing the ISO 8178 G2/D2 test procedures. The Tier 1 standards represent the first-ever set of federal standards for engines under 50 hp (37

kW). The Tier 2 and Tier 3 standards are proposed future requirements. The emission levels and effective years are shown in Table 7. The emission levels are measured utilizing test cycles dependent on engine size and application, i.e. 8-mode for variable speed engines, 5-mode for constant speed engines (generator sets), 6-mode for engines under 19 kW, and 4-mode for marine diesel engines.

TABLE 7: Emission Levels in grams/kW-hr and Effective Years							
Rated Brake Power (kW)	**Tier**	**Model Year**	**NOx**	**HC**	**NMHC + NOx**	**CO**	**PM**
kW<8	Tier 1	2000	------	------	10.5	8.0	1.0
	Tier 2	2005	------	------	7.5	8.0	0.80
8≤kW<19	Tier 1	2000	------	------	9.5	6.6	0.80
	Tier 2	2005	------	------	7.5	6.6	0.80
19≤kW<37	Tier 1	1999	------	------	9.5	5.5	0.80
	Tier 2	2004	------	------	7.5	5.5	0.60
37≤kW<75	Tier 1	1998	9.2	------	------	------	------
	Tier 2	2004	------	------	7.5	5.5	0.40
	Tier 3	2008	------	------	4.7	5.0	------
75≤kW<130	Tier 1	1997	9.2	------	------	------	------
	Tier 2	2003	------	------	6.6	5.0	0.30
	Tier 3	2007	------	------	4.0	5.0	------
130≤kW<225	Tier 1	1996	9.2	1.3	------	11.4	0.54
	Tier 2	2003	------	------	6.6	3.5	0.20
	Tier 3	2006	------	------	4.0	3.5	------
225≤kW<450	Tier 1	1996	9.2	1.3	------	11.4	0.54
	Tier 2	2001	------	------	6.4	3.5	0.20
	Tier 3	2006	------	------	4.0	3.5	------
450≤kW<560	Tier 1	1996	9.2	1.3	------	11.4	0.54
	Tier 2	2002	------	------	6.4	3.5	0.20
	Tier 3	2006	------	------	4.0	3.5	------
kW>560	Tier 1	2000	9.2	1.3	------	11.4	0.54
	Tier 2	2006	------	------	6.4	3.5	0.20

The EPA final rule as published in the Federal Register is included as Appendix C. On January 28, 2000 the California Air Resources Board adopted the EPA non-road diesel engine final rule. The California ARB ruling is included as Appendix D.

IV. SUMMARY

The critical fuel injection system components for the Tactical Quiet Generator (TQG) sets were identified and included in a fuel lubricity investigation. The investigation determined the impact of low-sulfur and high-sulfur fuels on fuel injection system wear. The component wear was evaluated for 200 hours at elevated fuel inlet temperatures, at increased fuel flow rates, and constant rack setting, to determine the relative wear of the fuel injection system barrel and plunger components with each fuel:

- High-sulfur and low-sulfur fuels completed 200-hour evaluation.
- Injection pump components inspections indicate low-sulfur diesel fuel operation should provide adequate durability.
- Slightly more polishing evident with the low-sulfur fuel, however the low-sulfur fuel evaluation was inadvertently performed at a higher injection rate.
- The pump performance characteristics were met at the end of testing with low-sulfur fuel.

In conjunction with an ongoing fuels survey at various military installations, a survey of generator set maintenance changes since the switch to low-sulfur diesel fuel was performed. The impact of the low-sulfur fuel on the readiness of older equipment should be reflected in the variation of the maintenance levels.

- No increases in generator set component usage had been reported since the switch to low-sulfur diesel fuel or JP-8.

The regional administrators of the ten EPA regions were contacted, and the points of contact for all 50 states for non-road emissions were attained. The majority of states will utilize the EPA guidelines for non-road emissions. The EPA final rule for non-road diesel engines and the California Air Resources Board adoption of the EPA final rule are included as appendices for reference. The EPA final rule outlines test methods and inspection intervals.

V. REFERENCES

1. Wei, D. and Spikes, H.A., “The Lubricity of Diesel Fuels,” Wear, Vol. III, 1986.

2. Butler, et. al., “Field Demonstration of Aviation Turbine Fuel MIL-T-83133C, Grade JP-8 (NATO Code F-34) at Fort Bliss, TX,” BFLRF No. 264, December 1990.

3. Butler, et. al., “Final Report on Field Demonstration of Aviation Turbine Fuel MIL-T-83133C, Grade JP-8 (NATO Code F-34) at Fort Bliss, TX,” BFLRF No. 278, September 1992.

4. Yost, D.M. and Montalvo, D.A., “Comparison of Diesel Exhaust Emissions Using JP-8 and Low-Sulfur Diesel Fuel,” BFLRF No. 264, December 1990.

APPENDIX A
40 CFR 89.908 NATIONAL SECURITY EXEMPTION

[Code of Federal Regulations]
[Title 40, Volume 17]
[Revised as of July 1, 2001]
From the U.S. Government Printing Office via GPO Access
[CITE: 40CFR89.908]

[Page 156-157]

TITLE 40--PROTECTION OF ENVIRONMENT

CHAPTER I--ENVIRONMENTAL PROTECTION AGENCY (CONTINUED)

PART 89--CONTROL OF EMISSIONS FROM NEW AND IN-USE NONROAD COMPRESSION-IGNITION ENGINES--Table of Contents

Subpart J--Exemption Provisions

Sec. 89.908 National security exemption.

(a)(1) Any nonroad engine, otherwise subject to this part, which is used in a vehicle that exhibits substantial features ordinarily associated with military combat such as armor and/or permanently affixed weaponry and which will be owned and/or used by an agency of the federal government with responsibility for national defense, will be considered exempt from these regulations for purposes of national security. No request for exemption is necessary.

(2) Manufacturers may request a national security exemption for any nonroad engine, otherwise subject to this part, which does not meet the conditions described in paragraph (a)(1) of this section. A manufacturer requesting a national security exemption must state the purpose for which the exemption is required and the request must be endorsed by an agency of the federal

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government charged with responsibility for national defense.

(b) EPA will maintain a list of models of nonroad engines (and the vehicles which use them) that have been granted a national security exemption under paragraph (a)(2) of this section. This list will be available to the public and may be obtained by writing to the following address: Group Manager, Engine Compliance Programs Group, Engine Programs and Compliance Division (6403J) Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460.

[61 FR 52102, Oct. 4, 1996]

APPENDIX B
REGIONAL BREAKDOWN OF REGULATIONS AND CONTACTS

REGION 1

John P. DeVillars **(617) 565-3400** **Boston**

- Connecticut
- Maine
- Massachusetts
- New Hampshire
- Rhode Island
- Vermont

CONNECTICUT

Carmine DeBattista	**(860) 424-3026**

A permit is needed is the potential to emit is equal to or greater than 100 tons per year of any individual air pollutant.

50 tons per year of volatile organic compounds or nitrogen oxides in any serious non-attainment areas for ozone.

25 tons per year of volatile organic compounds or nitrogen oxides in any severe non-attainment area.

MAINE

Jim Brooks	**(207) 287-2437**
Terry Hanson	**(207) 287-2811**

No regulations for mobile electric power generators

MASSACHUSETTS

Barbara Kwetz	**(617) 292-5593**
Mark Cohen	**(617) 292-5873**

Are exempt if having an energy input capacity less than or equal to 10,000,000 BTU per hour

Shall operate no more than 300 hours per rolling twelve month period. The operator shall establish and maintain records. A copy of the monthly log shall be submitted to Department.

This will satisfy Massachusetts non-attainment areas.

NEW HAMPSHIRE

Kenneth Colburn	**(603) 271-1380**
Craig Wright	**(603) 271-6791**
Kent	**(603) 271-1382**

Does not require a permit if under 30 days' usage.

Does not control or have emission regulations for mobile electric power sources.

RHODE ISLAND

Stephen Majkut **(401) 277-2808**

Has no regulations for mobile electric power generators, but an emergency standby internal combustion engine can only operate for less than 500 hours/year without a permit.

VERMONT

Richard Valentinetti **(802) 241-3840**

No regulations pertaining to mobile electric power generators.

REGION 2

Jeanne M. Fox	**(212) 637-3000**	**New York**

- New Jersey
- New York
- Puerto Rico
- Virgin Islands

NEW JERSEY

Yogsh Doshi **(609) 984-3023**

Mobile electric generators need a permit to operate if:

- The potential to emit is more than 100 tons per year carbon monoxide and PM-10, and 25 tons per year oxides of nitrogen.
- Emergency generator diesel engines have more than 10 megawatts of electrical output that operate for more than 500 hours per year.
- Commercial fuel burning equipment having a heat input rate of 1,000,000 BTU per hour or greater to the burning chamber.

NEW YORK

Randy Orr **(518) 457-7688**
Tom Christofell

Emergency power generating units and units that operate during emergency situations are exempt, which operate less than 500 hours/year. Any portable internal combustion engine located within any severe ozone non-attainment area, and have maximum power rating of less than 225 brake horsepower, or which are temporarily located at a facility for a period not to exceed 30 days per calendar year, where the total maximum mechanical power rating for all affected units is less than 1000 brake horsepower.

PUERTO RICO

VIRGIN ISLANDS

REGION 3

Stanley Laskowski	**(215) 566-2900**	**Philadelphia**

- Delaware
- Washington, DC
- Maryland
- Pennsylvania
- Virginia
- West Virginia

DELAWARE

Joseph Kliment **(302) 323-4542**

No permit is required for a diesel engine powered electric generator having BTU input between 1,000,000 and 10,000,000 BTU per hour used as an emergency standby source of electricity and annual operation does not exceed 150 hours.

WASHINGTON, DC

Don Wanbsgams **(202) 645-6093**
Sam Wiggins **Ext. 3273**

No regulations for mobile electric power generators because they are not used enough. If they are to be used on a regular basis, a permit could be necessary, especially for the larger generators.

MARYLAND

Merrylan Zaw-Mon **(410) 631-3280**

No regulation or permit required for mobile electric power generators.

PENNSYLVANIA

James Salvaggio **(717) 787-6548**

No regulations for mobile electric power generators that are not fixed for more than 30 days.

VIRGINIA

Peter Schmidt **(804) 762-4000**

Emergency electrical power generators that operate for less than 500 hours per year are exempt from the potential to emit rule and do not need a permit.

WEST VIRGINIA

Dale Farley **(304) 558-2455**

No regulations for mobile electric power generators.

REGION 4

John H. Hankinson, Jr. **(404) 347-4728** **Atlanta**

- Alabama
- Florida
- Georgia
- Kentucky
- Mississippi
- North Carolina
- South Carolina
- Tennessee

ALABAMA

Richard Grusnick **(334) 271-7861**

No mobile non-road regulation for mobile electric power generators.

FLORIDA

Howard Rhodes **(904) 488-0114**

No regulations pertain to mobile electric power generators.

GEORGIA

Ron Methier **(404) 363-7000**

No regulations for mobile electric power generators.

KENTUCKY

John Hornback **(502) 573-3382**
Roger Cook

Less than 5 tons per year of any pollutant falls under insignificant activities and are exempt for a permit.

MISSISSIPPI

Dwight Wylie **(601) 961-5171**

No regulations affecting our mobile electric power generators and no permit required.

NORTH CAROLINA

Alan Klimek **(919) 733-3340**

Less than 5 tons per year of any pollutant falls under insignificant activities and are exempt.

SOUTH CAROLINA

James Joy	**(803) 734-4750**

No permit shall be required for an emergency power generator of less than 150 kW rated capacity, or those which operate 250 hours per year or less, and record the actual hours used.

TENNESSEE

John Walton	**(615) 532-0554**
Greg Forte	**(615) 532-0548**

Internal combustion engine driven electric generators that are used only for emergency replacement or standby service are exempt from permit.

REGION 5

Valtas V. Admakus **(312) 886-3000** **Chicago**

- Illinois
- Indiana
- Michigan
- Minnesota
- Ohio
- Wisconsin

ILLINOIS

Mary Gade **(217) 782-9540**

No regulations covering the mobile electric power generator.

INDIANA

Cathy Prosser **(317) 232-8162**

No regulation covering the mobile electric power generators.

MICHIGAN

Rowland Armes **(517) 373-2329**

Electric power generators that burn diesel fuel that contains not more than 0.4% sulfur by weight and has a rated heat input capacity of not more than 20,000,000 BTU per hour are exempt from obtaining a permit.

MINNESOTA

Charles Williams **(612) 296-7301**

No regulation pertaining to mobile electric power generators.

OHIO

Donald Schregardus **(614) 644-2782**

Emergency electrical generators are exempt from a permit that are less than or equal to 50 horsepower that burn diesel fuel with less than or equal to 0.5 percent by weight sulfur. Emergency electrical generators greater than 50 horsepower that operate no more than 500 hours per rolling 12 month period and that burn diesel fuel with less than or equal to 0.5 percent by weight sulfur.

WISCONSIN

George Meyer **(608) 266-1099**

Semi-stationary diesel engines can not emit emissions of shade or density greater than number 2 on the Ringelmann chart of 40% opacity for longer than on aggregate time of 5 minutes in any 30-minute period. At no time may emissions exceed a shade or density greater than number 4 on the Ringelmann chart or 80% opacity. Also, no particulate matter in excess of 0.50 pound of particulate per million BTU heat input.

REGION 6

Jane N. Saginaw **(214) 665-2100** **Dallas**

- Arkansas
- Louisiana
- New Mexico
- Oklahoma
- Texas

ARKANSAS

Cecil Harold **(501) 682-0737**
Chief Engineering Supervisor

No regulations pertaining to mobile electric power generators.

LOUISIANA

Jay Dale Givens **(504) 765-0741**

Have no regulations but have a policy of testing 500 hp and over generators. If operated less than 30 days per quarter, need not be tested and are exempt.

NEW MEXICO

Mark Wilder **(505) 827-2855**

Mobile electric power generators are exempt if:

- Used during the unavoidable loss of Commercial utility power
- When used during military field exercises and weapon testing
- Power generators used in direct support of aircraft operations
- Total potential to emit of each regulated contaminant from all emission sources at the facility shall be less than 100 tons per year
- Any facility with a total potential to emit of any regulated contaminant greater than 200 tons per year

All diesel engines must use diesel fuel containing less than 0.3% by sulfur weight

With a possible exemption for military equipment in the near future

OKLAHOMA

Mark Coleman **(405) 271-8056**

No regulations for mobile power sources.

TEXAS

Dan Pierson **(512) 239-5440**

No regulations for mobile electric power generators, and are considered as emergency equipment.

REGION 7

Dennis Grams	**(913) 551-7676**	**Kansas City**

- Iowa
- Kansas
- Missouri
- Nebraska

IOWA

Peter Hamlin **(515) 281-8852**

Mobile internal combustion engines are exempt from having to get a permit.

KANSAS

John Irwin **(913) 296-1542**

No regulations for mobile non-road sources.

MISSOURI

Roger Randolph **(573) 751-4817**

No regulations specifically regarding our mobile electric power generators, but some may need to be reported for an application to permit to construct a significant source of emissions. The portable equipment is exempt if it produces less than 100 tons per year of any pollutant.

NEBRASKA

Shelly Katelly **(402) 471-2151**
Susan Fields **(402) 471-0019**

The state has no exhaust emission regulations. You have to meet the Federal regulations for exhaust emissions.

REGION 8

William Yellowtail **(303) 312-6308** **Denver**

- Colorado
- Montana
- North Dakota
- South Dakota
- Utah
- Wyoming

COLORADO

Thomas Looby	**(303) 692-3099**

Non-road internal combustion engines are exempt from the required Air Pollutant Emission Notice (APEN) or permit. Air Pollutant Emission Notice (APEN) are required for emergency and backup electric generators which are ancillary to the main units at electric utility facilities.

MONTANA

Mark Simonicki	**(406) 444-2544**
Charles Homer	**(406) 444-2544**

No specific regulations. They are written as a potential to omit emissions on a year-around basis. Any diesel engine that produces 25 tons per year of any pollutant need to have a permit.

NORTH DAKOTA

Francis Schwindt	**(701) 328-5150**

No regulations for mobile electric power generators.

SOUTH DAKOTA

Nettie Myers	**(605) 773-5559**

Diesel-powered emergency electrical generators are exempt from obtaining an operating permit.

UTAH

Dianne Nielson	**(801) 536-4402**
UNG	**(801) 536-0153**

Use the Federal non-road engine regulations and must use low sulfur diesel fuel.

WYOMING

Dennis Hemmer	**(307) 777-7938**

No permit required for mobile electric power generators that are operated for less than 500 hours per year. If any doubt, have equipment user contact local authorities.

REGION 9

Felicia Marcus **(415) 744-1001** **San Francisco**

- Arizona
- California
- Hawaii
- Nevada
- American Samoa
- Guam

ARIZONA

Russell Rhoades **(602) 207-2308**

No smoke for any period greater than 10 consecutive seconds which exceeds 40 percent opacity. Only the 500 kW and 750 kW units would require at least a Class II permit.

CALIFORNIA

John Dunlap **(916) 322-2900**

On-road motor vehicles or off-road vehicles or equipment owned by the U.S. Department of Defense (DOD) and/or the U.S. Military Services, and used in combat, combat support, combat service support, tactical or relief operations, or training for such operations are excluded and exempt from exhaust emission standards.

HAWAII

Lawrence Miike

NEVADA

L. H. Dodgion **(702) 687-4670**

No regulations for portable or mobile off-road equipment.

AMERICAN SAMOA

GUAM

Fred Castro **(671) 472-8862**

REGION 10

Charles Clarke **(206) 553-0479** **Seattle**

- Alaska
- Idaho
- Oregon
- Washington

ALASKA

Alvin Ewing	**(907) 271-5083**
Mike Mooney	**(907) 269-7500**

No restrictions or regulation on diesel mobile engines.

IDAHO

Lynn McKee	**(208) 334-1166**

Mobile internal combustion engines are exempt from permitting which have actual emissions of less than 100 tons per year of any contaminant of carbon monoxide, nitrogen oxide, sulfur dioxide, particulates (PM-10), ozone and lead, or would not significantly increase the emissions of a major facility. A permit is not generally required for emission units with below Federal regulatory emissions, or for temporary sources.

OREGON

Kenneth Brooks	**(503) 326-3250**
Dave Kauth	**(503) 229-5655**

Emergency power generators that are operated for less than 500 hours per year are exempt. For longer hours, the potential to emit 10 tons per year of any pollutant needs a permit.

WASHINGTON

Juhe Hagenson	**(360) 753-9083**
Tom Boucher	**(509) 454-7899**

Any source that has the potential to emit the following pollutants, at a rate of emission equal to or greater than any ofthe following rates:

Carbon monoxide	=	100 tons per year
Nitrogen oxides	=	40 tons per year
Particulate matter	=	25 tons per year
Fine particulate matter	=	15 tons per year

have to be registered with the ecology authority.

Stationary internal combustion engines rated at 500 horsepower or more shall register the source.

Any portable source that exceeds the above regulations can operate at the temporary location without registration if the ecology authority is provided with the intent to operate at the new location at least 30 days prior to starting operation.

APPENDIX C
ENVIRONMENTAL PROTECTION AGENCY
40 CFR PARTS 9, 86, AND 89
CONTROL OF EMISSIONS OF AIR POLLUTION FROM NONROAD DIESEL ENGINES
FINAL RULE

Friday
October 23, 1998

Part II

Environmental Protection Agency

40 CFR Parts 9, 86, and 89

Control of Emissions of Air Pollution From Nonroad Diesel Engines; Final Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 9, 86, and 89

[AMS–FRL–6155–3]

RIN 2060–AF76

Control of Emissions of Air Pollution From Nonroad Diesel Engines

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: In this action, EPA is finalizing new emission standards for nonroad diesel engines. The affected engines are used in most land-based nonroad equipment and some marine applications. The emission reductions resulting from the new standards will translate into significant, long-term improvements in air quality in many areas of the U.S. For engines in this large category of pollution sources, the standards for oxides of nitrogen and particulate matter emissions will be reduced by up to two-thirds from current standards. Overall, this program will provide much-needed assistance to states facing ozone and particulate air quality problems, which are causing a range of adverse health effects for their citizens, especially in terms of respiratory impairment and related illnesses.

In compliance with the Paperwork Reduction Act, this document announces that the information collection requirements contained in this rule were approved by the Office of Management and Budget.

DATES: The amendments to 40 CFR Parts 86 and 89 are effective December 22, 1998. The amendments to 40 CFR Part 9 are effective October 23, 1998. The incorporation by reference of certain publications listed in the regulations is approved by the Director of the Federal Register as of December 22, 1998.

ADDRESSES: Materials relevant to this rule, including the Final Regulatory Impact Analysis are contained in Public Docket A–96–40, located at room M–1500, Waterside Mall (ground floor), U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, DC 20460. The docket may be inspected from 8:00 a.m. until 5:30 p.m., Monday through Friday. A reasonable fee may be charged by EPA for copying docket materials.

For further information on electronic availability of this final rulemaking, see **SUPPLEMENTARY INFORMATION** below.

FOR FURTHER INFORMATION CONTACT: Alan Stout, U.S. EPA, Engine Programs and Compliance Division, (734) 214–4805; stout.alan@epamail.epa.gov.

SUPPLEMENTARY INFORMATION:

Regulated Entities

Entities potentially regulated by this action are those that manufacture or introduce into commerce new compression-ignition nonroad engines, vehicles, or equipment, and entities that rebuild or remanufacture nonroad compression-ignition engines. Regulated categories and entities include:

Category	Examples of regulated entities
Industry	Manufacturers of new nonroad diesel engines and equipment.
Industry	Rebuilders and remanufacturers of nonroad diesel engines.

This list is not intended to be exhaustive, but rather provides a guide for readers regarding entities likely to be regulated by this action. To determine whether particular activities may be regulated by this action, the reader should carefully examine the regulations, especially the applicability criteria in 40 CFR 89.1, and the existing regulatory language in 40 CFR Part 89. Questions regarding the applicability of this action to a particular entity may be directed to the person listed in **FOR FURTHER INFORMATION CONTACT.**

Obtaining Electronic Copies of the Regulatory Documents

The preamble, regulatory language and Final Regulatory Impact Analysis (Final RIA) are also available electronically from the EPA Internet Web site. This service is free of charge, except for any cost already incurred for internet connectivity. An electronic version of this final rule is made available on the day of publication on the primary Web site listed below. The EPA Office of Mobile Sources also publishes **Federal Register** actions and related documents on the secondary Web site listed below.

1. http://www.epa.gov/docs/fedrgstr/EPA-AIR/ (either select desired date or use Search feature)
2. http://www.epa.gov/OMSWWW/ (look in What's New or under the specific rulemaking topic)

Please note that due to differences between the software used to develop the document and the software into which the document may be downloaded, changes in format, page length, etc., may occur.

Table of Contents

I. Introduction

Air pollution continues to represent a serious threat to the health and well-being of millions of Americans and a large burden to the U.S. economy. Mobile source emission control programs, however, have a history of technological success that have made a very large contribution to reducing exposure to ambient air pollution. On June 17, 1994, the Environmental Protection Agency (EPA) made an affirmative determination under section 213(a)(2) of the Clean Air Act that nonroad engines are significant contributors to ambient ozone or carbon monoxide (CO) levels in more than one nonattainment area (59 FR 31306, June 17, 1994). In the same notice, EPA also made a determination under section 213(a)(4) that other emissions from compression-ignition (CI) nonroad engines rated at or above 37 kilowatts (kW), specifically emissions of particulate matter (PM) and smoke, cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare. Also in the June 1994 final rule, EPA set a first phase of emission standards ("Tier 1 standards") for nonroad diesel engines rated 37 kW and above.[1, 2] In the Notice

[1] Diesel-cycle engines, referred to simply as "diesel engines" in this document, may also be referred to as compression-ignition (or CI) engines. These engines typically operate on diesel fuel, but

of Proposed Rulemaking (NPRM) for this final rule (September 24, 1997, 62 FR 50152), EPA extended the finding under 213(a)(4) to CI nonroad engines rated under 37 kW. A more detailed discussion of the history of emission control programs for nonroad engines and other mobile sources is included in the preamble to the proposal for this rule.

In the NPRM, EPA estimated the contribution of nonroad diesel engines for comparison with other emission sources. For 1996, these engines were estimated to represent about 27 percent of mobile source emissions of oxides of nitrogen (NO_X) and 13 percent of total NO_X emissions. EPA estimates that these engines currently contribute about 48 percent of the directly emitted PM from mobile sources and 16 percent of total controllable PM emissions. In addition to directly emitted PM, EPA estimates that NO_X emissions cause a significant additional amount of PM in the form of secondary nitrate particles. On average nationwide, this indirect PM represents an additional contribution to PM equal to about 30 percent of the total directly emitted PM tonnage. EPA projections also indicate that without further emission controls, the already significant contribution of nonroad diesels to NO_X and PM will increase in the future. Chapter 5 of the Final Regulatory Impact Analysis (Final RIA) presents more complete estimates of emissions from all land-based nonroad diesel engines and marine diesel engines rated under 37 kW.[3]

This final rule is the result of several years of activity focused on reducing diesel engine emissions in the U.S. In 1994 and 1995, states and environmental groups encouraged EPA to adopt more stringent emission standards for highway and nonroad diesel engines to address the need for national pollution reduction measures to improve air quality in many urban areas. In response, EPA initiated discussions with engine manufacturers and other interested parties regarding future emission controls for these engines. EPA subsequently finalized new emission standards for heavy-duty highway engines starting with the 2004 model year (October 21, 1997 62 FR 54695) and proposed the emission requirements for nonroad diesel engines that are finalized in this document (September 24, 1997, 62 FR 50152).

This document finalizes a new set of emission standards for all nonroad diesel engines, except for locomotive engines, engines used in underground mining equipment, and marine engines rated at or above 37 kW. This rule includes first-ever EPA emission standards for emissions from diesel engines rated under 37 kW. The emission reductions resulting from these engines will be a major step in reducing the human health and environmental impacts of ground-level ozone and particulate matter. Emissions from other nonroad engines not covered by this final rule are being addressed in other EPA rulemakings.

As EPA has pursued the emission reductions needed to meet air quality goals, an important consideration has been harmonization with standards for nonroad engines adopted or under consideration in California, Europe, and elsewhere in the world. The goal of harmonization has been a major impetus and an important factor in the development of this rule. The principal goal of harmonization efforts, avoiding widespread duplicative design configurations, has been addressed in finalizing these emission standards. While some differences remain between EPA's final rule and the proposal established in Europe, EPA plans to continue its harmonization work with governments in Europe and in other countries. One major area in which a coordinated effort is being pursued is the development of a more effective particulate emission control program, including the evaluation and possible modification of the certification test cycle, as discussed in Section III.

Based on the information presented in the preamble to the proposed rule and in the Final RIA, EPA believes the new standards are technologically feasible and otherwise appropriate under the Act. Nonetheless, it is clear that a significant amount of research and development will be needed on the part of engine manufacturers and others to comply with the new standards. Accordingly, EPA intends to review the feasibility of some of the standards finalized in this document by 2001, as described in Section III.

II. Content of the Final Rule

This rulemaking includes a comprehensive program to reduce emissions from nonroad diesel engines and equipment. The program as finalized consists of stringent new emission standards, requirements to ensure that engines maintain their level of emission performance as they age, provisions providing compliance flexibility to engine and equipment manufacturers, and a voluntary program to encourage the introduction of low-emitting engines.

A. Emission Standards and Related Provisions

EPA is finalizing new emission standards for PM, CO, and nonmethane hydrocarbons (NMHC) and NO_X combined, covering all nonroad diesel engines except for locomotives, engines used in underground mining equipment, and large (rated at or above 37 kW) engines used in marine applications. Engines not included in this rulemaking are or will be addressed by other federal programs. EPA is finalizing a set of emission standards that vary in level and implementation date, depending on the rated power of the engine and other factors. The Agency believes that the standards finalized in this document are consistent with the Clean Air Act requirement that standards represent the ''greatest degree of emission reduction achievable'' given the criteria specified by the Act (see Section IV below).

1. Emission Standards

In general, new emission standards for engines rated between 37 and 560 kW are finalized in two tiers, building on the phase-in schedule adopted in 1994 in the Tier 1 rule. Table 1 lists the range of standards for the different power categories, including all the tiers of standards with the affected model years. These standards approximate the degree of control anticipated from existing standards covering engines used in heavy-duty diesel highway vehicles, with appropriate consideration of differences in the sizes and operational characteristics of the engines and in the organization of the industries. Specifically, the first set of new standards (Tier 2) generally parallel the emission standards that apply beginning with 1998 model year highway engines (58 FR 15781, March 24, 1993). The second set of new standards (Tier 3) parallel standards that apply beginning with 2004 highway engines (October 21, 1997, 62 FR 54695). The standards for engines rated at or above 37 kW become effective in the 2001 to 2006 time frame for Tier 2 levels and 2006 to 2008 for Tier 3 levels.

BILLING CODE 6560–50–P

other fuels may also be used. This contrasts with otto-cycle engines (also called spark-ignition or SI engines), which typically operate on gasoline.

[2] This rulemaking is based on metric units. With the exception of engine power ratings, English units are included parenthetically throughout the preamble. The conversion of engine power ratings is included in Table 1, but is not repeated in the rest of the document.

[3] See also, ''Nonroad Engine and Vehicle Emission Study—Report and Appendices,'' EPA–21A–201, November 1991 (available in Air Docket A–96–40).

Table 1
Emission Standards in g/kW-hr (g/hp-hr)

Engine Power	Tier	Model Year	NMHC + NOx	CO	PM
kW<8 (hp<11)	Tier 1	2000	10.5 (7.8)	8.0 (6.0)	1.0 (0.75)
	Tier 2	2005	7.5 (5.6)	8.0 (6.0)	0.80 (0.60)
8≤kW<19 (11≤hp<25)	Tier 1	2000	9.5 (7.1)	6.6 (4.9)	0.80 (0.60)
	Tier 2	2005	7.5 (5.6)	6.6 (4.9)	0.80 (0.60)
19≤kW<37 (25≤hp<50)	Tier 1	1999	9.5 (7.1)	5.5 (4.1)	0.80 (0.60)
	Tier 2	2004	7.5 (5.6)	5.5 (4.1)	0.60 (0.45)
37≤kW<75 (50≤hp<100)	Tier 2	2004	7.5 (5.6)	5.0 (3.7)	0.40 (0.30)
	Tier 3	2008	4.7 (3.5)	5.0 (3.7)	—
75≤kW<130 (100≤hp<175)	Tier 2	2003	6.6 (4.9)	5.0 (3.7)	0.30 (0.22)
	Tier 3	2007	4.0 (3.0)	5.0 (3.7)	—
130≤kW<225 (175≤hp<300)	Tier 2	2003	6.6 (4.9)	3.5 (2.6)	0.20 (0.15)
	Tier 3	2006	4.0 (3.0)	3.5 (2.6)	—
225≤kW<450 (300≤hp<600)	Tier 2	2001	6.4 (4.8)	3.5 (2.6)	0.20 (0.15)
	Tier 3	2006	4.0 (3.0)	3.5 (2.6)	—
450≤kW≤560 (600≤hp≤750)	Tier 2	2002	6.4 (4.8)	3.5 (2.6)	0.20 (0.15)
	Tier 3	2006	4.0 (3.0)	3.5 (2.6)	—
kW>560 (hp>750)	Tier 2	2006	6.4 (4.8)	3.5 (2.6)	0.20 (0.15)

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The standards finalized in this document for engines rated under 37 kW are the first EPA emission standards for these engines. The Tier 1 standards will be phased in by power category beginning in 1999, with Tier 2 standards phased in by power category beginning in 2004. Tier 3 standards are not being set for these engines, or for engines rated over 560 kW, in this rule.

In power categories for which Tier 3 standards are finalized, the Agency has chosen not to include more stringent PM standards. As discussed in Section III below, EPA has a number of reasons for deferring the establishment of a Tier 3 PM control program at this time, but is actively working toward this goal. The Agency believes that Tier 3 PM standards will be more appropriately discussed in the context of the improved technical understanding that will exist by the time of the 2001 feasibility review, also discussed in Section III.

EPA will maintain the current smoke standards for nonroad diesel engines rated at or above 37 kW and will extend the applicability of these standards to nonroad diesel engines rated under 37 kW, except 1-cylinder engines and marine propulsion engines. In addition, constant-speed engines are being exempted from smoke regulations. This is discussed in detail in Section II.H.

2. Related Provisions

a. Definition of Compression-Ignition. The requirements of 40 CFR Part 89 apply to all compression-ignition engines. Most current compression-ignition engines burn diesel fuel and operate over the conventional diesel cycle, which generally allows interchangeable use of the terms ''compression-ignition,'' ''diesel-cycle,'' and ''diesel.'' Some of these engines, however, can be modified to operate on other fuels such as natural gas or liquefied petroleum gas. Because these engines do not clearly fall into existing engine categories, EPA proposed a definition for nonroad compression-ignition engines that follows from definitions established for highway engines. The proposed definition focuses on the engine cycle, rather than the ignition mechanism, with the presence of a throttle as an indicator to distinguish between diesel-cycle and otto-cycle operation. Use of a throttle to regulate power (not just to maintain smooth low-load operation) corresponds with otto-cycle operation. Regulating power by controlling the fuel supply in lieu of a throttle corresponds with lean combustion and diesel-cycle operation. This language allows the possibility that a natural gas-fueled engine equipped with a sparkplug will be considered a compression-ignition engine, but EPA continues to believe that the proposed definition is the best way to segregate these engines. Nonroad engines fueled by natural gas could then fall under emission standards for nonroad diesel engines, finalized in this document, or for nonroad spark-ignition engines, which are currently under development. The supporting documentation for EPA's introduction of emission standards for methanol-fueled engines provides a more complete consideration of the different technologies involved and lays out a rationale for this conclusion.[4] To allow adequate time to certify engines that may be affected, this definition will take effect beginning January 1, 2000.

b. Hobby Engines. Many extremely small engines used to power model airplanes, model boats, and other such hobby equipment qualify as nonroad compression ignition engines. EPA is not establishing an emission standard for these small hobby engines at this time. These engines are designed and operated very differently than larger engines used in other applications. The Agency is not aware of information about these engines that would allow an assessment of the feasibility of the proposed standards, or help to establish feasible alternative standards, taking into consideration the factors relevant under section 213(a)(3) of the Act. Also, it is not clear whether such small engines could be appropriately and consistently tested with existing equipment, or, if so, whether any of the test cycles described below would adequately represent the in-use operation of these engines. Furthermore, EPA could not realistically impose the proposed useful life requirements or the warranty and maintenance interval provisions on these engines given their limited durability and frequent adjustment by the user. It should be noted that these engines have a low average annual hours of usage and an extremely low power output, and therefore contribute very little to the emissions inventory.

Although there are many distinguishing features of this hobby class of engines, the comments received on the proposal indicate that per-cylinder displacement provides an adequate and simple basis for distinguishing this class from other types of engines. Even though the Agency lacks the information that would allow a precise determination of the displacement level above which the proposed standards can be considered feasible, a displacement of 50 cubic centimeters per cylinder is well above the displacement level that is typical of this class of engines, and well below that of the smallest engines outside this group. Therefore, the final rule excludes engines with a displacement of less than 50 cubic centimeters per cylinder from the emissions standards in Part 89.

c. NMHC Measurement. EPA in this final rule changes from a measurement of total hydrocarbons to nonmethane hydrocarbons. There is, however, no standardized method for measuring methane in diesel engine exhaust. Therefore, EPA will allow manufacturers to develop and use their own procedure to analyze nonmethane hydrocarbons, with prior approval from EPA, or measure total hydrocarbons and subtract 2 percent from the measured hydrocarbon mass to correct for methane.

d. Selective Enforcement Audits. In the Tier 1 rule, the Agency adopted a program of Selective Enforcement Audits (SEAs) to ensure that actual production engines meet the emissions standards. The Agency is not making changes to this program. However, recognizing that engine manufacturers will be required to undertake significant engineering challenges in relatively short time frames in order to meet the Tier 2 and Tier 3 standards adopted in this rulemaking, including the challenge of stabilizing initial production variability, EPA will only impose SEAs during the first year in which a standard is in effect for those engine families where strong evidence exists that SEA failure would be likely.

B. Test Procedures

The standards finalized in this document are based on the use of EPA's existing steady-state (modal) test procedures. In addition, new steady-state test cycles are specified for constant-speed engines, marine propulsion engines, and engines rated under 19 kW. The Agency and the industry are working to better understand the sensitivity of nonroad diesel engine emissions to the test cycle, as discussed in Section III. The following sections describe EPA's selection of various test cycles and fuel specifications.

1. Test Cycles

Compliance with emission standards is determined by measuring emissions while operating engines over a prescribed test cycle. The final rule, following the practice established in the

[4] ''Summary and Analysis of Comments on the Notice of Proposed Rulemaking for Emission Standards and Test Procedures for Methanol-Fueled Vehicles and Engines,'' EPA, January 1989.

Tier 1 rule, specifies a cycle that is nominally the same as the International Organization for Standards (ISO) 8178 C1 test cycle as the principle test cycle for measuring emissions from most engines. Additional cycles are defined for specific engine types. Engines that are limited by design to constant-speed operation will be subject to testing using a test cycle equivalent to the ISO 8178 D2 cycle. This cycle, which omits idle and intermediate-speed modes from the C1 cycle, is representative of engines such as generators, which are designed never to run at these omitted speeds.[5] Because of the more limited range of engine operation in the D2 cycle, manufacturers must ensure that engines certified with data generated with the D2 cycle are used exclusively in constant-speed applications. Accordingly, these engines must include labeling information indicating this limited emission certification.

For variable-speed engines rated under 19 kW, EPA is specifying a test cycle that is equivalent to the ISO 8178 G2 cycle. The G2 cycle includes the same modes as the D2 cycle and adds a mode for operation at idle. The G2 and D2 cycles also have different weighting factors for the various modes. The G2 cycle was developed to represent the operation of small diesel engines used primarily at rated speed, such as in lawn and garden applications, generators, pumps, welders, and air compressors. EPA is specifying a test cycle equivalent to the ISO 8178 E3 cycle for testing propulsion marine engines rated under 37 kW. The E3 cycle, which consists of engine operation at four different engine speeds and four different loads, was developed by ISO to represent the operation of propulsion marine engines, and has been supported by an Agency investigation. Auxiliary marine engines subject to this rule (i.e., engines installed on a marine vessel, but not used for propulsion) will be tested using the either G2, C1, or D2 test cycles, consistent with the constraints described above for the counterpart land-based nonroad engines.

Finally, EPA will generally allow manufacturers to use the C1 test cycle to generate certification data for engines otherwise required to use the D2 or G2 test cycle. EPA will also allow manufacturers to use the C1 test cycle to generate certification data for propulsion marine engines where such engines are included in a land-based engine family. In each of these cases in which the manufacturer elects to use the C1 cycle, EPA would retain its ability to test using the respective G2, D2, or E3 test cycle, but would also be able to test using the C1 test cycle. Additional discussion of EPA plans for further evaluation and development of appropriate test cycles is provided in Section III.

2. Test Fuel

Section 206(h) of the Clean Air Act requires that test fuels be representative of in-use conditions. Therefore EPA is updating the specifications for the sulfur content in diesel test fuels to make them more representative of in-use fuels. EPA is finalizing test fuel specifications with a sulfur specification of 0.03 to 0.40 weight-percent (wt%), which covers the range of sulfur levels observed for most in-use fuels. The final sulfur specifications are slightly different from that proposed (0.05 to 0.5 wt%), because EPA believes the final specification more appropriately covers the range of sulfur levels found in the majority of in-use fuels. Manufacturers will be free to test using any fuel within this range. Thus, they will be able to harmonize their nonroad test fuel with either on-highway testing (<0.05 wt%) or with European testing (0.1 to 0.2 wt%). Testing conducted by EPA would use test fuels typical of in-use fuels.

At this time, EPA believes that the average sulfur level of diesel fuel being used in current nonroad engines is on the order of 0.2 wt%. In order to provide manufacturers with some certainty regarding how EPA will implement its test fuel policy, the Agency is including a regulatory provision specifying that it will use test fuels with sulfur levels no greater than 0.20 wt% when it performs testing of Tier 1 engines and Tier 2 engines rated at or above 37 kW. EPA is not applying this provision to Tier 3 engines or Tier 2 engines rated under 37 kW because those standards do no take effect for some time, and EPA has no basis for determining what the properties of in-use fuels for these engines will be. Moreover, EPA has not determined that it would be an appropriate long-term policy to specify a narrow range for the sulfur specification. This would be especially true for engines utilizing catalytic aftertreatment to reduce particulate emissions. Such engines may comply with the emission standards when tested using a moderately low sulfur fuel, but have much higher particulate emissions when using a higher sulfur fuel with a sulfur level between 0.3 and 0.4 wt%. Although not addressing it at this time, EPA intends to examine test fuels for Tier 3 engines and Tier 2 engines rated under 37 kW in its 2001 feasibility review.

In the 1994 final rule, EPA allowed manufacturers to test for certification of PM emission levels using the low-sulfur test fuel specified by the California Air Resources Board (California ARB) for nonroad diesel engines, with a maximum sulfur content of 0.05 wt%. EPA's objective was to minimize any difference from the protocol previously established for California, because EPA finalized PM standards for engines rated over 130 kW only in response to industry's request to adopt California's PM standard, which was not considered technology-forcing. Under those previous regulations, testing with federal test fuel involved an optional adjustment of measured PM levels to account for the higher PM emissions associated with the higher fuel sulfur content.

Effective with the Tier 2 standards (and Tier 1 standards for engines rated under 37 kW), EPA is eliminating the particulate adjustment factor for test fuels with different sulfur levels. Such an adjustment, while potentially appropriate for an initial, modest particulate emission control program for a newly regulated industry, is not appropriate as a long-term policy. EPA is now establishing PM standards that will require meaningful reductions from all sizes of engines used nationwide. The Clean Air Act requires EPA to ensure that the test procedure, including fuel specifications, adequately represent in-use operation. Moreover, EPA has significant concerns regarding the accuracy of the previously used adjustment factor equation, which was based on limited data. However, even if more complete data were available, it would not be possible for a single adjustment factor equation to accurately predict the effect of different sulfur levels on particulate emissions for each engine model. This is because the effect of sulfur levels on particulate emissions can vary significantly from engine family to engine family, especially for engines with and without aftertreatment.

EPA recognizes that the sulfur level of test fuels has an effect on the stringency of the standards, and that the elimination of the particulate adjustment factor has the effect of making the particulate standards more stringent than they otherwise would have been. Using the calculated adjustment to PM emission levels for fuel sulfur finalized in 1994, the difference between 0.20 and 0.05 wt% would result in an adjustment on the order of 0.03 grams per kilowatt-hour (g/

[5] For a description of the development of the D2 cycle, see "Exhaust Emission Testing of Diesel Engines for Industrial Applications," (Docket A–96–40, item II-D–26).

kW-hr) (0.02 grams per horsepower-hour (g/hp-hr)) in PM emission levels. (Testing for NO_X, NMHC, CO, and smoke is not affected, since the 1994 final rule already specified that federal test fuel was appropriate without adjustment for measuring emissions of those pollutants.) However, EPA has considered this effect in making its determination that the standards being adopted in this rulemaking are feasible.

C. Durability

To achieve the full benefit of the emissions standards, programs are necessary to encourage manufacturers to design and build engines with durable emission controls and encourage the proper maintenance and repair of engines throughout their lifetime. The goal is for engines to maintain good emission performance throughout their in-use operation.

When the Tier 1 standards for engines rated at or above 37 kW were developed, deterioration was not expected to be a problem for two reasons. First, the Tier 1 standards were not considered by EPA to be technology forcing. Second, the focus was on NO_X control and NO_X emissions performance was thought not to deteriorate for these engines. As a result, there are few requirements in the current regulations that address deterioration concerns for nonroad diesel engines. As tighter standards are put into place, EPA believes that it becomes necessary to adopt measures to address concerns about possible in-use emission performance degradation.

EPA is making some changes to the existing durability program, as the new standards are phased in, to help ensure that engines meet applicable standards in use. The specific areas of the durability program that are being focused on here are useful life, warranty period, deterioration factors, allowable maintenance intervals, and rebuilding requirements.

1. Useful Life

Currently, nonroad diesel engines rated at or above 37 kW are defined, for emission control purposes, to have a useful life of 8,000 hours or 10 years, whichever occurs first. The in-use testing liability period is currently 6,000 hours or 7 years, whichever occurs first. Based on a study performed for EPA, this is representative of the average time until first rebuild for the majority of nonroad diesel engines.[6] EPA is making no changes to these requirements.

EPA is adopting a shorter useful life and liability period for engines rated under 37 kW than for larger engines. Based on EPA's current understanding, these smaller engines have a shorter life expectancy. Also, engines rated under 37 kW that operate constantly at high speeds (at or above 3000 revolutions per minute (rpm)) and very small engines (those rated under 19 kW) have a shorter life expectancy than other small engines. As a result, EPA has adjusted the useful lives and liability periods for these engines accordingly. Table 2 presents the specified useful lives and in-use testing liability periods being adopted.

TABLE. 2—USEFUL LIFE AND RECALL TESTING PERIODS

Power rating	Rated engine speed	Useful life		Recall testing period	
		Hours	Years	Hours	Years
<19 kW	All	3,000	5	2,250	4
19–37 kW	Constant speed engines @≥3,000 rpm	3,000	5	2,250	4
	All others	5,000	7	3,750	5

Liability periods were based on the ratio of useful life and liability periods established for engines rated at or above 37 kW. The purpose of having liability periods that are shorter than the useful lives is to ensure that engines used in recall testing are not statistical outliers with poor emissions durability. However, if a recall were ordered, all engines in that family would be subject to the recall regardless of their age.

2. Warranty Period

Tied to the useful life is the minimum warranty period imposed by the Clean Air Act on manufacturers of nonroad engines. Currently, the minimum warranty period for nonroad diesel engines rated at or above 37 kW is 3,000 hours or 5 years of use, whichever occurs first. EPA is extending this minimum warranty period to most engines rated between 19 and 37 kW; however, for engines under 19 kW and for 19 to 37 kW constant speed engines rated at 3000 rpm and above, EPA is specifying a warranty period of 1,500 hours or 2 years, whichever occurs first. The shorter warranty requirement for these engines is due to their shorter useful lives.

3. Deterioration Factors

In the Tier 1 nonroad engine rule, EPA did not require manufacturers to accumulate operating time on durability data engines or to generate deterioration factors for engine certification because that rule focused on modest reductions in NO_X emissions, requiring emission control technologies that were not expected to deteriorate. Analysis of highway engine data at that time led EPA to conclude that heavy-duty diesel engines do not generally produce more NO_X emissions as they get older. EPA believes that this stability of emission control can be attributed to the fact that diesel engine manufacturers have met emission standards through internal improvements to the engine and fuel systems, rather than relying on aftertreatment and other devices that would be more susceptible to in-use degradation. In fact, engine deterioration in current technology nonroad diesel engines could result in lower NO_X emission levels due to a loss in cylinder compression.

As NO_X, NMHC, and PM standards are made more stringent and nonroad diesel engine manufacturers introduce new technologies solely for emission control purposes, such as aftertreatment, sophisticated fuel delivery controls, and exhaust gas recirculation (EGR), long-term emissions performance becomes a greater concern. In addition, emission deterioration characteristics are not well known for aftertreatment, EGR, and other more sophisticated emission control strategies.

EPA will require the application of deterioration factors (DFs) to all engines covered by this rule. The DF is a factor applied to the certification emission test data to represent emissions at the end of the useful life of the engine. Separate DFs apply to each measured pollutant, except that a combined NMHC + NO_X DF applies to engines that do not use aftertreatment devices, consistent with the form of the standard. Consistent

[6] ICF Incorporated, "Industry Characterization: Nonroad Heavy Duty Diesel Engine Rebuilders," prepared for U.S. Environmental Protection Agency, Contract 68–C5–0010, WAN 102, January 3, 1997, (Docket A–96–40, item II–A–02).

with the approach taken in other EPA programs, decreasing emissions of one pollutant over time would not be allowed to offset increasing emissions of the other pollutant in this combined DF. Currently, DFs are required for highway heavy-duty engines but are only required for nonroad diesel engines rated at or above 37 kW if engines use aftertreatment technologies. Deterioration factors for those engines are to be determined by the engine manufacturers in accordance with good engineering practices. EPA has not set a specified procedure. The deterioration factors are nevertheless subject to EPA approval.

It is not EPA's intent to force a great deal of data gathering on engines using established technology for which the manufacturers have the experience to develop appropriate DFs. New DF testing may not be needed where sufficient data already exists. EPA's main interest is that technologies with unproven durability in nonroad applications, such as EGR, are demonstrated to meet emission requirements throughout their useful lives. However, because this rule creates a program that will introduce new standards and new technologies over many years, the DF requirement is being finalized for all engines so that EPA can be sure that reasonable methods are being used to ascertain the capability of engines to meet standards throughout their useful lives. This DF program will allow EPA to act in the traditional role of establishing emission performance standards, rather than putting EPA in a position in which it would appear to be prejudging the durability of specific technologies and designs.

Similar to the provisions for highway engines, EPA will allow the nonroad engine manufacturers the flexibility of using durability emission data from a similar engine that has either been certified to the same standard or for which all of the data applicable for certification has been submitted. In addition, EPA is extending this flexibility to allow deterioration data from highway engines to be used for similar nonroad engine families.

EPA is especially concerned that an unnecessarily burdensome durability demonstration not be required for engines using established technology for which the manufacturers have the experience to determine appropriate deterioration factors. In these cases, EPA will allow nonroad engine manufacturers to perform an analysis, based on good engineering practices, in place of actual service accumulation. For instance, in the case where no durability data exists for a certain engine but both smaller and larger engines using similar technology have been shown not to deteriorate for NO_X in use, it would be possible to build a case showing no NO_X deterioration for that engine. EPA is allowing engines to be considered as using established technologies if they do not meet the Tier 3 emission standards, unless they use EGR or aftertreatment devices. In addition, manufacturers of engines that do meet the Tier 3 standards but have technologies similar to those employed in Tier 2 designs may also rely on engineering analysis in lieu of actual service accumulation, with prior EPA approval.

Because there may be insufficient time for manufacturers of engines rated below 37 kW to verify DFs before the Tier 1 compliance dates, the Agency is allowing manufacturers to specify DFs for these engines in model years 1999 and 2000 based on good engineering judgement using reasonably available information. Any requests for carryover of these models into the 2001 model year would need to include justification of DFs under the new requirements.

4. Allowable Maintenance Intervals

Manufacturers are currently required to furnish the ultimate purchaser of each new nonroad engine with written instructions for the maintenance needed to ensure proper functioning of the emission control system. Generally, manufacturers require the owners to perform this maintenance as a condition of their emission warranties. Further, the performance of maintenance would be considered during any in-use recall testing conducted by the Agency.

For the engines covered in this action, EPA believes that there is a need to limit the minimum maintenance intervals specified by the manufacturers, to ensure that the technologies employed are practical in use. Because the actual maintenance intervals for nonroad engines are likely to be similar to highway engines, EPA proposed maintenance requirements parallel those for highway engines (40 CFR 86.094–25).

There are two aspects to the implementation of allowable maintenance interval requirements. The first relates to the maintenance instructions specified by manufacturers in users manuals. The second concerns how often maintenance has been or will be performed on engines undergoing testing to verify compliance with emission standards. Ideally these would be consistent. However, due to concerns about the need for more frequent maintenance in the severe operating environments that nonroad engines sometimes operate in, EPA is focusing its allowable maintenance interval requirements on testing performed by manufacturers to demonstrate compliance. This testing would not, of course, occur in severe operating environments. Manufacturers have a business incentive to avoid specifying overly frequent maintenance in user manuals, and so EPA is not, at this time, insisting that the intervals be reflected in user manuals. In addition, manufacturers may adopt shorter intervals for engines rated below 19 kW and 19 to 37 kW constant speed engines rated at 3000 rpm and above, subject to EPA approval. Subject to these modifications, the Agency is finalizing the proposed allowable maintenance interval requirements.

The following minimum intervals are being adopted for adjustment, cleaning, repair, or replacement of various components:

At 1,500 hours, and 1,500-hour intervals thereafter:

1. EGR related filters and coolers
2. Positive crankcase ventilation valve
3. Fuel injector tips (cleaning only)

At 3,000 hours, and 3,000-hour intervals thereafter for engines rated under 130 kW or 4,500-hour intervals thereafter for engines rated over 130 kW:

1. Fuel injectors
2. Turbocharger
3. Electronic engine control unit and its associated sensors and actuators
4. PM trap or trap-oxidizer system
5. EGR system (including all related control valves and tubing)
6. Catalytic convertor
7. Any other add-on emissions-related component

Add-on emission-related components are those whose sole or primary purpose is to reduce emissions or whose failure will significantly degrade emission control, yet not significantly affect the performance of the engine.

In addition, EPA is defining the following components as critical emission-related components:

1. Catalytic convertor
2. Electronic engine control unit and its associated sensors and actuators
3. EGR system (including all related filters, coolers, control valves and tubing)
4. Positive crankcase ventilation valve
5. PM trap or trap-oxidizer system
6. Any other add-on emissions-related component

If maintenance is scheduled on critical emission-related components in-use, EPA requires that the manufacturer show the reasonable likelihood that the maintenance will, in fact, be performed

in use. The regulations list options for this demonstration, including showing that performance would degrade without maintenance, providing survey data showing that the maintenance is performed, using a visible signal system, offering free maintenance, and other methods approved by the Administrator. These special provisions do not apply to critical emission-related components for which no maintenance is specified over the useful life of the engine.

5. Rebuilding Requirements

In this action, EPA is addressing two concerns regarding the rebuilding of nonroad diesel engines, both related to new emission-related components that may be added to the engine to meet the new standards. First, EPA is concerned that during engine rebuilding, there may not be an incentive to check and repair emission controls that do not affect engine performance. Second, EPA is concerned that there may be an incentive to rebuild engines to an older configuration due to real or perceived performance penalties associated with technologies that would be used to meet the standards finalized in this document. Such practices would likely result in a loss in emission control.

EPA is requiring that parties involved in the process of rebuilding or remanufacturing engines (which may include the removal of the engine, rebuilding, assembly, reinstallation and other acts associated with engine rebuilding) must follow the provisions listed below to avoid tampering with the engine and emission controls. The applicability for these provisions is based on the date the engine was originally built. The rebuild requirements only apply to engines subject to the new standards being established in this rule.

(1) During engine rebuilding, parties involved must have a reasonable technical basis for knowing that the rebuilt engine is equivalent, from an emissions standpoint, to a certified configuration (i.e., tolerances, calibrations, and specifications), and must identify the model year(s) of the resulting engine configuration. This allows for a rebuilder who is unable to identify the original certified configuration to rebuild the engine to any certified configuration.

(2) When an engine is being rebuilt and remains installed or is reinstalled in the same piece of equipment, it must be rebuilt to a configuration of the same or later model year as the original engine. When an engine is being replaced, the replacement engine must be an engine of (or rebuilt to) a certified configuration that is equivalent, from an emissions standpoint, to the engine being replaced. This allows for rebuilt engine configurations that, although of a different model year than the original engine, were designed for the same tier of emission standards. If the replacement engine is new, it must also meet the requirements of 40 CFR 89.1003(b)(7), discussed in section II.E.3 below.

(3) At the time of rebuild, emission-related codes or signals from on-board monitoring systems may not be erased or reset without diagnosing and responding appropriately to the diagnostic codes. Diagnostic systems must be free of all such codes when the rebuilt engines are returned to service. Further, such signals may not be rendered inoperative during the rebuilding process.

(4) When conducting an in-frame rebuild or the installation of a rebuilt engine, all emission-related components not otherwise addressed by the above provisions must be checked and cleaned, repaired, or replaced where necessary, following manufacturer recommended practices.

Under this final rule, any person or entity engaged in the process, in whole or part, of rebuilding engines who fails to comply with the above provisions may be liable for tampering. Parties are responsible for the activities over which they have control and as such there may be more than one responsible party for a single engine in cases where different parties perform different tasks during the engine rebuilding process (e.g., engine rebuild, full engine assembly, installation). EPA has included no certification or in-use emissions requirements for the rebuilder or engine owner in this final rule.

EPA has adopted modest recordkeeping requirements that EPA believes are in line with customary business practices. The records must be kept by persons involved in the process of nonroad engine rebuilding or remanufacturing and shall include the best available information on the total operating hours at time of rebuild and a list of the work performed on the engine and related emission control systems, including a list of replacement parts used, engine parameter adjustments, design element changes, and work performed as described in item (4) of the rebuild provisions above. EPA now requires that such records be kept for two years after the engine is rebuilt.

Under this final rule, parties are required to keep the information for two years but are allowed to use whatever format or system they choose, provided that the information can be readily understood by an EPA enforcement officer. EPA will not require that parties keep information that they do not have access to as part of normal business practice. In cases where it is customary practice to keep records for engine families rather than specific engines, where the engines within that family are being rebuilt or remanufactured to an identical configuration, such recordkeeping practices should be satisfactory. Rebuilders may use records such as build lists, parts lists, and engineering parameters of the engine families being rebuilt rather than keeping information on individual engines, provided that each engine is rebuilt in the same way to those specifications.

D. Averaging, Banking, and Trading

In this final rule, EPA is replacing the existing nonroad engine averaging, banking, and trading (ABT) program with a comprehensive new program. EPA believes the revised program is an important element in making the stringent emissions standards adopted in this final rule appropriate with regard to technological feasibility, lead time, and cost. The revised ABT program is intended to enhance the flexibility offered to engine manufacturers that will be needed in transitioning their entire product lines to meet the stringent NMHC + NO_X standards and the PM standards being adopted. The ABT program also encourages the early introduction of cleaner engines, thus securing earlier emission benefits. It should be noted that as part of the 2001 feasibility review described earlier, the Agency plans to reassess the appropriateness of the averaging, banking, and trading provisions applicable to nonroad diesel engines and modify the provisions if deemed necessary.

The revised ABT program will apply to all nonroad diesel engines subject to Part 89. The following discussion of the revised ABT provisions is divided into two sections. The first section describes the provisions for engines rated at or above 37 kW. The second section describes the provisions for those engines rated under 37 kW, including land-based and marine engines, both of which are currently unregulated by EPA.

1. Revised Program for Engines Rated at or Above 37 kW

The following section is divided into two subsections and describes the revised ABT program for engines at or above 37 kW. The first subsection describes the general provisions

applicable to all engines. The second subsection describes several provisions specific to engines certified to the existing Tier 1 standards for engines at or above 37 kW.

a. General Provisions. Beginning with the Tier 2 standards, the form of the standard changes from separate hydrocarbon and NO_X standards to a combined NMHC + NO_X standard. Therefore, once the Tier 2 standards take effect, credits will be based on combined NMHC + NO_X values. In the Tier 2 time frame, NMHC + NO_X credits will be generated against the Tier 2 standards, which vary from 6.4 to 7.5 g/kW-hr (4.8 to 5.6 g/hp-hr), depending on the power rating of the engine. In the Tier 3 time frame, NMHC + NO_X credits will be generated against the Tier 3 standards, which vary from 4.0 to 4.7 g/kW-hr (3.0 to 3.5 g/hp-hr), depending on the power rating of the engine.

The existing Tier 1 ABT program for nonroad engines does not cover PM emissions. Beginning with the introduction of Tier 2 engines, EPA is including PM emissions in the ABT program in order to provide manufacturers with greater flexibility in complying with the new PM standards. (As described later, EPA is allowing the early banking of PM credits from Tier 1 engines.) All PM credits will be generated against the Tier 2 standards until EPA adopts subsequent PM standards. Because EPA is including both NMHC + NO_X and PM in the ABT program and given the tradeoff between NO_X and PM emissions, manufacturers will not be allowed to generate credits against the applicable standard for one pollutant while using credits against the applicable standard for another pollutant on the same engine family.

EPA is setting upper limits to the family emission limit (FEL) values that may be declared under the new standards. EPA is adopting an NMHC + NO_X FEL upper limit of 10.5 g/kW-hr (7.9 g/hp-hr) for engines at or above 130 kW certified in the Tier 2 time frame. For Tier 2 engines at or above 37 kW and less than 130 kW, EPA is adopting a NMHC + NO_X FEL upper limit of 11.5 g/kW-hr (8.6 g/hp-hr). For Tier 3 engine families, the NMHC + NO_X FEL upper limits are the Tier 2 NMHC + NO_X standards for the same power category of engines.

For PM, EPA is adopting a PM FEL upper limit of 0.54 g/kW-hr (0.40 g/hp-hr) for engines at or above 130 kW certified in the Tier 2 time frame. Engines at or above 37 kW and less than 130 kW will have a PM FEL upper limit of 1.2 g/kW-hr (0.9 g/hp-hr) for Tier 2 engines. (EPA is not adopting a PM FEL upper limit beyond Tier 2 because EPA is not adopting Tier 3 PM standards at this time.)

There are several other provisions EPA is adopting for the revised ABT program. EPA is replacing the three year credit life provision of the existing ABT program with no limit on credit life. In addition, EPA is eliminating the ''buy high/sell low'' power conversion factor provision of the existing ABT regulations and replacing it with a sales-weighted average power value. EPA is including an adjustment in the calculation of credits for the useful life of the engine. (The existing ABT program does not include any adjustment for useful life to the credit calculations.) EPA is also allowing manufacturers to include engines certified to meet the State of California's standards in the revised ABT program because the California ARB is expected to adopt the same standards for their nonroad compression-ignition engine control program.

In a similar manner to the existing ABT provisions for Tier 1 engines at or above 37 kW, EPA is not requiring any discounting of credits from Tier 2 or Tier 3 engines with this final rulemaking. EPA plans to monitor the emission levels of engines and the use of the ABT program over the next few years. EPA will take this information into account and plans to reassess the appropriateness of not having any discounting of credits from Tier 2 and Tier 3 engines as part of the 2001 feasibility review.

Finally, EPA has decided not to finalize two ABT provisions discussed in the proposal for this rule. First, as discussed later in the equipment manufacturer flexibility section, EPA is not adopting the proposed provision that would have given engine manufacturers the option to trade the NMHC + NO_X and PM credits generated by their engines to equipment manufacturers. This is discussed further in Section II.E of this final rule. Second, EPA is not adopting a restriction which would have limited the use of PM credits to the power category in which the credits were generated. As with the existing Tier 1 ABT program, credits may be exchanged across all power categories at or above 37 kW. (As described below, there are some restrictions on the trading of credits for engines below 37 kW and trading credits between land-based applications and marine applications.)

b. Special Provisions for Tier 1 Engines. As described above, EPA is replacing the existing ABT program with a comprehensive new program. Based on EPA's experience with Tier 1 certification and because of implementation differences between the existing Tier 1 provisions and the newly adopted Tier 2 and later provisions, EPA is adopting two changes that will specifically affect engines certified to the existing Tier 1 standards. First, EPA is adopting a methodology for calculating NO_X credits earned from Tier 1 engines that can be used for showing compliance with the Tier 2 NMHC + NO_X standards. Second, EPA is allowing engine manufacturers to bank early PM credits from Tier 1 engines that can be used once the newly adopted Tier 2 standards take effect. The changes noted in the general provisions discussion above, including the unlimited life, use of average power for credit calculations, and useful life adjustment, will also apply to engines certified to the existing Tier 1 standards.

With regard to the generation of NO_X credits from engines certified to the existing Tier 1 standards, EPA will continue to allow manufacturers to earn NO_X credits, but not NMHC + NO_X credits. The NO_X credits earned on engines certified to the existing Tier 1 standards can be used to show compliance with the current Tier 1 NO_X standard or the newly adopted Tier 2 NMHC + NO_X standards. However, due to concerns over the potential to delay the Tier 3 standards with credits earned from Tier 1 engines, the NO_X credits earned on engines certified to the existing Tier 1 standards cannot be used to show compliance with the newly adopted Tier 3 NMHC + NO_X standards.

With regard to the calculation of NO_X credits from Tier 1 engines that are to be banked or traded and subsequently used for Tier 2 NMHC + NO_X compliance, EPA is requiring that the value of the NO_X credits be discounted unless the engine on which the credits were earned is below the applicable Tier 1 standard by a specified amount. EPA believes this requirement is appropriate due to concerns that manufacturers could potentially earn significant NO_X credits from their current Tier 1 engines and delay compliance with the Tier 2 standards, and also to encourage the pull-ahead of newer and cleaner technologies. (Credits from Tier 1 engines that are to be used to show compliance for other Tier 1 engines, are not required to be discounted.) EPA is adopting a trigger mechanism to distinguish between Tier 1 engine families which are eligible for no adjustment and those families which must be adjusted. For engine families certified with a NO_X FEL at or below 8.0 g/kW-hr (6.0 g/HP-hr), no discount will be applied to any NO_X credits. For engine families certified at a NO_X FEL above the 8.0 g/kW-hr trigger in the Tier

1 time frame, the value of the NO_X credits will be discounted by 35 percent.

With regard to PM credit generation, EPA is allowing early banking of PM credits from Tier 1 engines as soon as this final rule becomes effective. Under the revised program, the number of PM credits generated will be calculated against the Tier 2 standards and may only be used to show compliance once the Tier 2 PM standards take effect. Neither the trigger nor the credit discounting concept described above for Tier 1 NO_X credits, will apply to PM credits.

EPA requested comment on some additional limitations regarding the use of credits generated from Tier 1 engines. EPA is not adopting a provision that would apply a surcharge to NO_X credits used by a manufacturer to certify more than 20 percent of its fleet. EPA is also not adopting any limit on the number of years a manufacturer may earn early PM credits from Tier 1 engines.

2. Program for Engines Rated Under 37 kW

As noted earlier, EPA is adopting standards for engines rated under 37 kW. These engines are currently unregulated by EPA. Therefore, the existing ABT program did not apply to such engines. EPA is adopting provisions to include both land-based and marine engines rated under 37 kW in the revised ABT program. A number of issues have been addressed for these engines, including credit generation, credit life, credit calculation, trading across power categories, credit exchange between land-based and marine applications, and a special multi-year averaging and banking program. The following section addresses each of these issues.

With regard to credit generation, EPA is making credits available for both NMHC + NO_X emissions and for PM emissions as soon as the standards become effective. Because many of the engines below 19 kW use indirect injection technology, which tends to low-emitting, EPA is requiring that all credits generated from engines rated under 19 kW be calculated against the Tier 2 standards, even prior to the Tier 2 time frame. This requirement applies for both NMHC + NO_X credits and PM credits. For engines rated at or above 19 kW and less than 37 kW, where direct injection engines are more common, EPA is requiring that all engines generate credits against the applicable standards.

For Tier 1 engines below 37 kW, EPA is adopting FEL upper limits of 16.0 g/kW-hr (12.0 g/hp-hr) for NMHC + NO_X and 1.2 g/kW-hr (0.9 g/hp-hr) for PM. These levels are based on existing California ARB standards for nonroad diesel engines rated under 19 kW. The FEL upper limits for the Tier 2 standards are the Tier 1 standards.

With regard to credit life, EPA is adopting the unlimited life provisions for engines rated under 37 kW, as described earlier for engines rated at or above 37 kW, with one exception. Because of concerns over the amount of credits manufacturers could earn on indirect injection engines under the newly adopted Tier 1 standards and the potential for significant delay in implementation of the Tier 2 standards, EPA is requiring that all credits generated prior to the Tier 2 time frame on engines rated under 19 kW expire at the end of 2007.

With respect to credit generation and usage calculations, EPA is requiring that manufacturers use the sales-weighted average power for engines rated under 37 kW, as described earlier for engines rated at or above 37 kW. The inclusion of useful life in the calculation of credits, as described earlier, will also apply to the revised ABT program for engines rated under 37 kW.

With respect to trading across power categories, EPA is adopting two restrictions on such trading because of concerns regarding excessive credit generation by low-emitting indirect injection engines. First, EPA will not allow manufacturers to use credits generated on engines rated under 19 kW to demonstrate compliance for engines rated at or above 19 kW. Second, EPA is prohibiting manufacturers from trading credits earned on indirect injection engines rated at or above 19 kW to other manufacturers. (This restriction applies to engines at or above 37 kW as well.) Under this second restriction, a manufacturer would still be allowed to use such credits for averaging or banking purposes with other engines rated at or above 19 kW that the manufacturer produces itself. As part of the 2001 feasibility review described earlier, the Agency plans to reassess the appropriateness of these restrictions and modify them as appropriate.

With respect to the exchange of credits across applications, EPA is adopting provisions that will prohibit manufacturers from using credits generated on land-based engines to demonstrate compliance for marine engines. EPA is concerned that manufacturers making engines used in both marine and land-based applications could effectively trade out of the marine portion of the program giving them a competitive advantage over small marinizers who only sell marine engines. EPA will, however, allow manufacturers to use credits generated on marine engines to demonstrate compliance for land-based applications.

Finally, EPA is adopting a special four-year averaging and banking program for engines rated under 37 kW due to the short lead time before the Tier 1 standards begin to apply. The program would apply separately to engines rated under 19 kW and to engines rated at or above 19 kW and less than 37 kW. Under the special program, manufacturers will be allowed to create a negative balance of credits for the first two years the Tier 1 standards apply. This negative balance will have to be eliminated by the end of the fourth year after the Tier 1 standards become applicable along with a ten percent penalty for any negative balance of credits carried over from one year to the next. Under this special program, manufacturers will not be allowed to use emission credits obtained through trading with other engine manufacturers to offset their negative credit balances. The manufacturer must offset their negative balances within positive credits generated from their own engines.

E. Flexibility for Equipment Manufacturers

In implementing the new standards, EPA desires to avoid unnecessary hardship for equipment manufacturers (sometimes referred to as original equipment manufacturers or OEMs), who install diesel engines in their products. There is concern that engine suppliers may not always provide adequate lead time for the equipment redesigns needed to accommodate engine design changes such as mounting locations and heat rejection loads. For some OEMs, even timely information on the new engine designs may not be sufficient because of the sheer volume of redesign work needed to change diverse product offerings with limited engineering staffs.

In response to these concerns, the Agency is including in this final rule an OEM transition program to provide equipment manufacturers with some control of the transition process to new standards. The design of this program is based on extensive discussions with involved parties prior to the proposal, on recommendations made in the report of the panel convened for this rule under the Small Business Regulatory Enforcement Fairness Act of 1996

(SBREFA),[7] and on written comments received on the proposal. It represents an effort on the part of the Agency to accommodate the flexibility needs of an extremely diverse industry without introducing competitive advantages, and while maintaining the environmental benefit sought in the standard-setting program.

The OEM transition program consists of four major elements, each directed at a specific need. Although they involve certain planning and recordkeeping responsibilities if taken advantage of, all of these elements are voluntary. An OEM has the option to continue to do business as under the current regulations, subject to the prohibited acts provisions of 40 CFR Part 89, Subpart K.[8] The elements of the program are a percent-of-production allowance, a small-volume allowance, continuance of the Tier 1 allowance to use up existing inventories of engines, and availability of hardship relief. Each of these is discussed in detail below.

One element of the proposed program that is not being finalized is a provision for OEMs to obtain and use ABT program credits. The ABT provision is not being finalized because it would likely be little used and would greatly complicate the ABT program. It should be noted that OEMs may achieve a similar benefit by working to have their engine suppliers directly obtain and retire ABT credits in order to produce more previous-tier engines for the OEM. Further explanation of this decision is provided in the Summary and Analysis of Comments for this final rule.

Another proposed program element that is being approached differently concerns an expanded exemption allowance for farm and logging equipment. EPA's rationale for limiting special treatment to farm and logging equipment was not supported by commenters, even those who were likely to benefit from it. Commenters identified a wide range of other applications and special situations that involved the same or comparable considerations as those related to farm and logging applications. As described further in the Percent-of-Production Allowance discussion below, EPA is therefore allowing expanded flexibility for all applications equally, not just for farm and logging equipment.

1. Percent-of-Production Allowance

Each equipment manufacturer may install engines not certified to new emission standards in a limited percentage of machines produced for the U.S. market. This percentage applies separately to each power category and is expressed as a cumulative percentage of 80 percent over the 7 years beginning when the Tier 2 standard first applies in the category (Tier 1 for power categories under 37 kW). No exemptions are allowed after the seventh year. For example, an OEM may exempt 40 percent of its 1999 production of machines that use engines rated between 19 and 37 kW, 30 percent of its 2000 production, and 10 percent of its 2001 production. If the same OEM were to produce machines using engines rated between 8 and 19 kW, a separate cumulative percentage allowance of 80 percent would apply to these machines during the seven years beginning in 2000.

The Agency recognizes that the 80 percent exemption allowance, were it to be used to its maximum extent by all OEMs, would bring about the introduction of cleaner engines several months later than would have occurred if the new standards were to be fully implemented on their effective dates. However, the Agency notes too that the allowance is truly that—an allowance to be tapped as needed to assist OEMs in dealing with implementation problems that might arise. EPA is aware that many engine designs being planned for the new standards will fit the equipment with little change. Also, the desire of engine manufacturers to avoid producing two engine designs that, from an applications perspective, are redundant, will prompt them to change over to the new designs as quickly as they can accommodate their customers' needs. Although there is no way of knowing at this time how many exempted engines will be produced, the Agency believes it will be substantially less than the allowance. Moreover, the OEM flexibility program has been integrated with the standard-setting process from the beginning of this rulemaking, and as such it is a key factor in enabling the initiation of new standards according to the adopted schedule.

Machines that use engines built before the standard goes into effect need not be included in the exemption count. Engines that produce emissions at higher levels than the standards, but for which the engine manufacturer uses ABT program credits to demonstrate compliance, count as complying engines. In power categories above 37 kW, the exempted engines must comply with Tier 1 standards. In power categories below 37 kW, the exempted engines may be uncertified.

The Agency has expanded the percent-of-production allowance from the proposed level because numerous commenters pointed out that there are applications other than farm and logging equipment for which the proposed allowance is inadequate. The Agency reviewed these comments and concluded that some additional flexibility is warranted to meet the requirements of paragraph 213(a)(3) of the Clean Air Act calling for the ''greatest degree of emission reduction achievable'' given certain criteria, including ''the cost of applying such technology within the time available to manufacturers''. The Agency is also convinced by the comments and its own review of equipment redesign challenges that the need for this flexibility is widespread across the regulated power bands. For example, many smaller engines must fit into very compact equipment packages for which cost considerations are paramount; farm equipment predominates in the medium-size power bands; and the largest engines are typically used in very low sales-volume equipment models, for which aggressive redesign schedules may be costly or impossible.

This approach is superior to attempting to identify all applications and situations deserving of special treatment and either assigning individual allowances to them or granting exemptions on a request basis, because it maintains the proposal's focus on giving OEMs long-range control over how they use their assigned pool of exemptions for their products affected by each new set of standards, rather than on dictating category-by-category or model-by-model allowances. It also serves the goal of avoiding unnecessary complexity by avoiding the need for numerous equipment category definitions and exemption ''account'' calculations, a goal that was supported by several commenters.

The choice of a cumulative percent allowance of 80 percent is based on the Agency's best estimate of the degree of flexibility needed to meet the requirements of the Clean Air Act. EPA believes the 80 percent allowance responds to the need for flexibility identified by commenters while ensuring approximately the same level of emission reductions originally proposed. EPA has examined the impact on environmental benefits of the combination of changes being finalized

[7] ''Final Report of the SBREFA Small Business Advocacy Review Panel for Control of Emissions of Air Pollution from Nonroad Diesel Engines'', May 23, 1997 (available in Air Docket A–96–40).

[8] Section 89.1003(a)(6) has been revised in the final rule to clarify that certificates of conformity will not be required for engines and equipment manufactured in compliance with the flexibility provisions of the rule. See ''Revision of Prohibited Acts Regulatory Text,'' EPA memorandum from Charles Moulis to Docket A–96–40, August 26, 1998.

for this program, including this expanded allowance for all equipment and the decision to treat agricultural equipment as part of this pool. Although the actual impact will depend on the degree to which the industry takes advantage of the flexibility provisions, the Agency has determined that the net effect will be roughly equivalent to the impact of the proposed program. The Summary and Analysis of Comments document and the Final RIA provide additional information regarding this decision and its net environmental impact.

2. Small Volume Allowance

The percent-of-production approach described above may provide little benefit to small businesses focused on a small number of equipment models. Therefore EPA is allowing equipment manufacturers to exceed the percent-of-production allowances described above during the same years affected by the allowance program for general applications, provided they limit the number of exempted engines used in each power category to 700 total over the 7 years, and to 200 in any one year. In addition, manufacturers making use of this provision must limit exempted engines to a single engine family (or to a single manufacturer for engines rated under 37 kW) in each power category. These restrictions are considered necessary to maintain the intent of this provision—helping small businesses with limited product offerings—rather than giving bigger exemption allowances for larger OEMs who can effectively use the percent-of-production provisions.

3. Existing Inventory Allowance and Replacement Engines

The Tier 1 rule for engines rated at or above 37 kW included a provision for OEMs to continue to use uncertified engines built prior to the effective date of Tier 1 standards, until uncertified engine inventories are depleted. It also prohibited purposeful stockpiling of uncertified engines. EPA is extending this provision to the Tier 1-to-Tier 2 and Tier 2-to-Tier 3 transitions, as well as to the under 37 kW engines. The existing provision that provides an exception to the Tier 1 compliance regulations for the sale of replacement engines is also being extended to engines covered by this action. In extending this provision, the Agency is requiring that engines built to replace certified engines be identical in all material respects to an engine of a previously certified configuration that is of the same or later model year as the engine being replaced. The term ‘‘identical in all material respects’’ allows for minor differences that would not reasonably be expected to affect emissions.

4. Hardship Relief Provision

EPA is providing a safety valve provision whereby an OEM that does not make its own engines could obtain limited additional relief by providing evidence that, despite its best efforts, it cannot meet the implementation dates, even with the OEM transition program provisions outlined above. Such a situation might occur if an engine supplier without a major business interest in the OEM were to change or drop an engine model very late in the implementation process. This concept was put forward for consideration in this rulemaking by the Small Business Advocacy Review Panel convened under SBREFA, as a means of addressing small business concerns. Comments received on the proposal, however, have convinced the Agency that these concerns are not limited to small businesses.

Appeals for hardship relief must be made in writing, must be submitted before the earliest date of noncompliance, must include evidence that failure to comply was not the fault of the OEM (such as a supply contract broken by the engine supplier), and must include evidence that serious economic hardship to the company will result if relief is not granted. The Agency intends work with the applicant to ensure that all other remedies available under the flexibility provisions are exhausted before granting additional relief, and would limit the period of relief to no more than one year. Furthermore, applications for hardship relief will only be accepted during the first year after the effective date of an applicable new emission standard.

To avoid the creation of a self-fulfilling prophecy, by which the very existence of this provision prompts engine manufacturers to delay engine developments, the Agency wishes to make clear that it expects this provision to be rarely used. Each granting of relief would be treated as a separate agreement with no prior guarantee of success, and with the inclusion of measures, agreed to in writing by the OEM, for recovering the lost environmental benefit.

5. Enforcement and Recordkeeping Requirements

Engine manufacturers will be allowed to continue to build and sell the engines needed to meet the market demand created by the OEM transition program, provided they receive written assurance from the engine purchasers that such engines are being procured for this purpose. Engine manufacturers who participate in this program will be required to annually provide information on the number of such engines produced and on who they are provided to, in order to help EPA prevent abuse of the program.

OEMs choosing to take advantage of the allowances must: (1) keep records of the production of all pieces of equipment excepted under the allowance provisions for at least two full years after the final year in which allowances are available for each power category; (2) include in such records the serial and model numbers and dates of production of equipment and installed engines, rated power of each engine, and the calculations used to verify that the allowances have not been exceeded in each power category; and (3) make these records available to the Agency upon request. The Agency intends to conduct only limited audits of these records, and expects that scrutiny by the OEMs of their competitors' products will help identify potential candidates for audits.

Secondary manufacturers who modify or relabel and resell new equipment already introduced into commerce would be subject to the regulations in the same way as independent dealers and distributors. These regulations primarily concern tampering. EPA's desire to limit the number of machines using noncomplying engines is therefore satisfied by regulation of the original equipment manufacturers who install the engine into the machine, such that the secondary manufacturers do not need exemption allowances. They may sell as many machines with noncomplying engines as they are legally able to obtain.

All entities that are under the control of a common entity, and that meet the definition of a nonroad vehicle or nonroad equipment manufacturer, must be considered together for the purposes of applying exemption allowances. This provides certain benefits for the purpose of pooling exemptions but also precludes the abuse of the small volume allowances that would exist if companies could treat each operating unit as a separate OEM.

EPA recognizes that the OEM transition program may involve a certain amount of complexity and administrative burden that was not present for OEMs under the Tier 1 rule, which limited the compliance options for OEMs. However, this program is entirely voluntary and manufacturers wishing to implement the new standards in the same manner as for the

Tier 1 regulations are free to do so. The Agency intends to develop guidance to assist OEMs in taking advantage of these provisions, but also intends to fully enforce the regulations in order to ensure a fair implementation process that achieves the environmental benefit sought in setting new standards.

F. Flexibility for Post-Manufacture Marinizers

Post-manufacture marinizers (PMMs) produce marine engines by modifying engines purchased from other manufacturers. They are therefore subject to both the engine manufacturer's concern about certifying engines to the standards and the OEM's concern about timely delivery of redesigned engines from their engine suppliers.

EPA recognizes that the potential unavailability of certified base engines may make it difficult for PMMs to comply with the proposed emission control program, since they may not be able to obtain base engines in time to adjust their marinization process, especially considering that most of the marine engines affected by this rule are subject to standards beginning in 1999. Based on these concerns, EPA has determined that the proposed emission standards would not be feasible for PMMs who produce marine engines under 37 kW without some flexibility provisions beyond those available in the ABT program. As a result EPA is finalizing two additional flexibility provisions for PMMs.

First, the OEM flexibility provisions discussed above are being extended to PMMs, as proposed. Second, provided they inform EPA in writing before the date Tier 1 standards would take effect, PMMs may elect to delay the effective dates applicable to marine engines under 37 kW for one year, instead of using the OEM flexibility provisions. PMMs may not take advantage of both the delayed effective date provision and the OEM flexibility provisions.

Although it provides a substantial boost in certainty to PMMs, the optional 1-year delay provision will have a very small environmental impact. This is because: (1) the marine engines under 37 kW produced by PMMs are a very small part of the total nonroad diesel engine production, (2) these engines produce relatively low emissions due to their small size and low usage characteristics, and (3) the total number of engines potentially exempted under this flexibility provision is not much greater than that possible under the exemption allowance provisions.

G. Control of Crankcase Emissions

Crankcase gases are those exhaust gases that discharge (blowby) into the crankcase via the clearance between the piston and the cylinder wall. On most engines (those engines with open crankcases), these gases eventually escape from the crankcase into the atmosphere. Some manufacturers produce engines that route crankcase vapors to the air intake system of the equipment; such a design is called a closed crankcase. This method, also called positive crankcase ventilation, recirculates blowby gases through a valve back to the intake manifold to be burned in the combustion chamber.[9]

Since 1985, closed crankcases have been required in naturally aspirated (non-turbocharged) highway diesel engines (45 FR 4136, January 21, 1980). Turbocharged engines have not been required to have crankcase emission controls due to concerns related to problems associated with the durability and effectiveness of turbocharger and aftercooler components which can be affected by recycling gases containing particulate matter and corrosive gases. EPA is extending the closed crankcase requirement to nonroad engines, including the exemption for turbocharged diesel engines. Many naturally aspirated nonroad engines are already equipped with this technology; for those nonroad engine models still manufactured with open crankcases, EPA expects that closed-crankcase technology will be readily transferable. EPA has included the cost of closing crankcases in the analysis of the costs of complying with the new standards. EPA had originally proposed to apply the closed crankcase requirement to some Tier 1 engines, but has now decided to apply it only Tier 2 and later naturally aspirated engines because of lead-time concerns. This delay will not have a major environmental impact because it is short, directed at a small segment of the engine market, and confined to a minor emission source relative to exhaust emissions.

EPA will also allow manufacturers to comply with this requirement by routing the crankcase emissions into the exhaust. Manufacturers choosing this option would effectively be required to reduce their engine-out exhaust emissions further than other manufacturers that choose to route the crankcase emissions into the engine intake. It is important to note that this optional approach will require that the engine (and equipment) be designed so that the routing would occur under all in-use conditions. Manufacturers using this approach will be required to modify their deterioration factors to account for increases over time in crankcase emissions. EPA will also consider using this approach in the future for controlling crankcase emissions from turbocharged engines, which are currently uncontrolled. The advantage of this approach is that allows manufacturers the flexibility to either route crankcase emissions into the engine intake, thereby combusting the crankcase emissions of hydrocarbons and CO, or to route the emissions into the exhaust (where they would be measured as part of the exhaust emissions) and to reduce the total exhaust emissions using other means.

H. Control of Smoke

1. Standards and Procedures

In 1994, EPA finalized smoke standards for nonroad diesel engines rated at or above 37 kW. The specified measurement method and calculations are from 40 CFR Part 86, Subpart I, which was developed for highway engines. EPA is making no major changes to the smoke emission standards and procedures currently in place.

EPA is extending the smoke standards to diesel engines rated under 37 kW, bringing these engines under the same regulatory framework as the larger engines. While these new standards may lead to lower smoke levels from some engines, the principal intent of setting standards is to prevent increased levels of smoke as engines are redesigned to comply with Tier 2 and Tier 3 standards for gaseous and particulate emissions. The same numerical standards apply to the small engines. With minor exceptions, the same procedure, equipment, and calculation methods are also specified for these engines.

In applying the smoke standards and procedures to engines rated under 37 kW, EPA has chosen to exempt one-cylinder engines. EPA believes that operation and testing of these engines is unique in ways that would need to be addressed before applying smoke standards. For example, one-cylinder engines operating on the specified test procedure produce puffs of smoke that may make the smoke measurement erratic. EPA is therefore postponing the regulation of smoke from these one-cylinder engines until a later rulemaking. The Agency believes the air quality impact of this postponement will be minimal because the large majority of one-cylinder diesel engines are used in generator sets and other

[9] U.S. Environmental Protection Agency, Office of Mobile Sources, NEVES, Appendix I, Chapter 4, November 1991 (available in Air Docket A–96–40).

steady-state applications, which rarely experience acceleration modes—the principal focus of smoke standards. In a similar manner, because two-cylinder engines operating on the specified test procedure may also produce puffs of smoke that would make the smoke measurement erratic, though to a lesser degree than single-cylinder engines, EPA will permit manufacturers the option of testing two-cylinder engines with a preconditioned muffler of the type used in the field. Such an engine configuration is the same as that found in use, and thus will ensure meaningful control of in-use smoke, even though instantaneous smoke emissions may be flattened out somewhat, resulting in potentially reduced levels of measured smoke. Engines with more than two cylinders will continue to be tested without a muffler, which is a ''worst case'' condition.

EPA is also slightly modifying the exhaust pipe diameter specifications found in 40 CFR Part 86, Subpart I. The previous specifications called for a 2 inch (5 centimeters (cm)) inside diameter exhaust pipe for testing any engine rated under 101 horsepower (hp) maximum (75 kW), and a 5 inch (13 cm) inside diameter exhaust pipe for the testing any engine with a rated power of 301 hp (225 kW) or greater. In this action, the Agency is specifying that engines rated between 50 and 100 hp (37 and 75 kW) be tested with a 2 inch (5 cm) inside diameter exhaust pipe, while engines rated under 50 hp (37 kW) should be tested with an exhaust pipe of 1.5 inches (3.8 cm). EPA is also specifying that all engines rated over 500 hp (373 kW) should be tested with an exhaust pipe of 6 inches (15.2 cm).

EPA is not establishing smoke requirements for propulsion marine diesel engines rated under 37 kW. EPA has concluded that the existing smoke test procedures are not appropriate for small propulsion marine engines. The Agency believes that the small environmental risks associated with smoke emissions from such engines do not justify the creation of special smoke test procedures for them at this time. EPA expects to reconsider this issue in the future at the same time that it reconsiders other smoke issues. Finally, EPA is dropping smoke requirements for constant speed engines until a smoke test becomes available for these engines, because the current smoke test cannot effectively be performed on them. The Agency believes the air quality impact will be minimal because these engines do not often experience acceleration modes, which are the principal focus of smoke standards.

2. Future Reconsideration of Smoke Issues

An International Standards Organization committee (ISO TC70/SC8/WG1) has been developing a smoke test procedure specifically for nonroad engines. The EPA and regulated industry recognize the value of harmonized test procedures and standards limits. However, this ISO procedure has not been finalized and thus is not included in this rulemaking. EPA has analyzed the draft ISO procedure (8178–9) and concluded that most of its elements would be appropriate for adoption. Thus, the Agency expects that it will adopt the ISO smoke measurement procedure after it is finalized. At that time EPA may also reconsider the issues related to the use of mufflers, single-cylinder and two-cylinder engines, constant speed engines, marine engines and standard exhaust pipe diameters. It is important to note that the ISO 8178–9 smoke emissions test procedure is very different from the procedure specified in Subpart I of Part 86. As a consequence , if EPA adopts the ISO 8178–9 procedure, then it will also need to revise the numerical limit values to be associated with the ISO procedure. EPA believes the appropriate numerical standard that should be associated with ISO 8178–9 peak measurements is likely to be within the range of 20 to 30 percent opacity. It is important to note, however, that this is only a preliminary estimate.

EPA also expects to give future consideration to the need for an in-use smoke test. Some state governments have expressed a desire for a smoke regulatory program that would enable them to test in-use nonroad engines in a manner that would permit action against gross emitters of smoke. The main elements of such a program would be a certification smoke requirement for new engines, EPA guidance for state in-use smoke control programs (including an in-use smoke test procedure and accompanying limit values), and a means by which the data from the two programs could be related. The current smoke test procedure from Part 86, Subpart I, does not provide data comparable to the most practical in-use smoke test procedure (a snap acceleration with measured opacity). Based on the current draft ISO 8178–9 certification smoke test procedure, EPA believes the future ISO test will provide the desired linkage.

I. Voluntary Low-Emitting Engine Program

Officials representing certain cities, states, or regions in the U.S. have expressed interest in developing incentive programs to encourage the use of engines that go beyond federal emission standards. EPA also would like to encourage manufacturers to initiate demonstration projects to prove out these technologies in areas where there is a particular need for superior emission controls. EPA is therefore finalizing a set of voluntary standards that may be used to earn a designation as a ''Blue Sky Series'' low-emitting engine. The program, if successful, will lead to the introduction and more widespread use of these low-emission technologies. Possible incentives to encourage production of these engines are described below.

Central to the purpose of the voluntary standards is the need to demonstrate superior control of particulate emissions. Because of the sensitivity of particulate emissions to test cycles, as described in Section III, testing on a transient cycle is an important element of the program for Blue Sky Series engines. EPA has begun work toward developing transient test cycles for nonroad equipment, but there is not yet any established or proven nonroad transient cycle. The highway test cycle, while not developed for nonroad engine operation, would result in a significant degree of control for nonroad equipment. EPA has therefore specified the highway transient test cycle to evaluate emission levels relative to the voluntary standards. If EPA adopts a transient test for certifying nonroad engines in the future, the Agency will accordingly re-evaluate the test cycle and standards for Blue Sky Series engines.

To best align with future emission standards, Tier 3 emission levels, where applicable, were chosen as the best level for defining Blue Sky Series engines. This represents a reduction of approximately 40 percent beyond the Tier 2 NMHC + NO_X levels. For PM emissions and for engines with no Tier 3 standards, a calculated level corresponding to a 40 percent reduction beyond Tier 2 levels will be used to qualify as a Blue Sky Series engine (see Table 3).

TABLE 3.—VOLUNTARY EMISSION STANDARDS IN G/KW-HR (G/HP-HR)

Rated brake power (kW)	NMHC+NO_X	PM
kW<8	4.6 (3.4)	0.48 (0.36)

TABLE 3.—VOLUNTARY EMISSION STANDARDS IN G/KW-HR (G/HP-HR)—Continued

Rated brake power (kW)	$NMHC+NO_X$	PM
8≤kW<19	4.5 (3.4)	0.48 (0.36)
19≤kW<37	4.5 (3.4)	0.36 (0.27)
37≤kW<75	4.7 (3.5)	0.24 (0.18)
75≤kW<130	4.0 (3.0)	0.18 (0.13)
130≤kW≤560	4.0 (3.0)	0.12 (0.09)
kW>560	3.8 (2.8)	0.12 (0.09)

Blue Sky Series engines need to meet all the requirements that would otherwise be applicable to Tier 2 engines. This would include allowable maintenance, warranty, useful life, rebuild, and deterioration factor provisions. Manufacturers must demonstrate compliance with the CO standard by comparing the emission levels generated on the highway test cycle with the numerical value of the CO standard for the applicable tier of nonroad engines for that model year. Manufacturers must also demonstrate compliance with applicable smoke standards.

Repeating the certification process to develop and submit test data to make a highway engine available for nonroad use adds a significant hurdle to engines expected to sell in low volumes for nonroad applications. Under the Blue Sky Series engine program, manufacturers with highway-certified engines may waive the testing requirements for obtaining nonroad certification. This includes the need to comply with the provisions related to the durability of emission controls. EPA, however, needs to ensure that engine designs are not tailored to the transient cycle with much higher emissions on a steady-state cycle. To accommodate this, EPA retains the ability to conduct in-use testing to verify that engines are operating in steady-state modes with substantially the same level of emission control. EPA will therefore require that NO_X and PM emissions be no more than 20 percent higher on the appropriate nonroad steady-state test cycle compared with the highway test cycle. This is intended to provide relief for development testing needed to protect against in-use liability, while preventing any active strategies designed specifically for the transient test cycle at the expense of controlling emissions during steady-state operation. For evaluation of the performance of one of these engines in steady-state operation at any point in an engine's useful life, the Agency intends to conduct paired data generated on both the appropriate steady-state test cycle and the highway transient test cycle.

The Blue Sky Series program begins immediately upon promulgation and continues through the 2004 model year. EPA will evaluate the program to determine if it should be continued for 2005 and later engines, and if so, what changes are needed to reflect the transition to Tier 3 emission standards. This evaluation will be considered as part of the 2001 feasibility review. The experience gained with these engines and the Tier 3 resolution of certification test cycles and PM standards will factor into this evaluation.

The Agency sees substantial potential for users and state and local governments to establish these incentive programs. For example, the increasing public concern about the effects of diesel engine emissions on health raises the possibility that some construction companies will purchase Blue Sky Series engines to protect its workers or the public from localized emissions, especially if benefits can also be gained in employee or public relations, such as with highly visible projects in polluted city centers. Similarly, a mining company could select these low-emitting engines for underground applications to minimize miners' exposure to exhaust pollutants. A state or local government may be able to add incentives for companies committing to rely on Blue Sky Series engines in contract bidding on publicly funded construction projects in nonattainment areas. Some farmers may be willing to pay more for equipment with the cleaner engines to lower their field exposure to engine exhaust pollutants. In some of these applications, alternative fuels may be readily available, possibly even providing a cost savings compared to diesel fuel.

The Agency is concerned that incentive programs not lead to a net detriment to the environment through the double-counting of benefits. Also, manufacturers have indicated that the potential to participate in an averaging, banking, and trading program would not be an important factor leading to the development of Blue Sky Series engines. EPA has therefore concluded that manufacturers choosing to sell an engine with the Blue Sky Series designation will not generate averaging, banking, and trading credits for demonstrating compliance with EPA programs. Other groups are then free to design credit programs without concern for any double-counting or other unintended effect of overlapping programs.

J. Technical Amendments

This final rule contains technical amendments to the certification and emission test procedures previously adopted for nonroad diesel engines (40 CFR Part 89). The most significant changes are highlighted here; a complete description of the technical amendments is detailed in a memorandum to the docket.[10]

EPA is adding definitions of rated speed and intermediate speed. Rated speed is defined as the maximum full load speed for governed engines and speed of maximum horsepower for ungoverned engines. The definition for intermediate speed was based on peak torque speed and limits intermediate speed to 60 to 75 percent of rated speed. The maximum full load speed is the highest speed with an advertised power greater than zero. EPA is linking full load governed speed to advertisements at this time since no adequate language has been developed that mathematically defines full load governed speed as a point on the torque or power curve. Power curves in manufacturer's advertisements typically end at the governed speed. EPA believes that manufacturers will continue to advertise the full range of power of its engine. Manufacturers would therefore not set rated speed at less than full load governed speed. It is unlikely that manufacturers will advertise powers beyond the full load governed speed, since a manufacturer cannot guarantee power beyond this point. EPA is applying the new definitions to Tier 1, as well as Tier 2 and 3 programs. However, to avoid unnecessarily burdensome recertification, EPA is not requiring manufacturers to use the new definitions for Tier 1 engines certified prior to January 1, 1999. Engine families that are certified prior to January 1, 1999 may carry over certification under the old definitions into subsequent Tier 1 model years. All Tier 2 engines must meet the definitions for rated and intermediate speeds.

Engines are grouped into families that are expected to have similar emissions characteristics throughout their useful lives. EPA's regulations list a number of characteristics which distinguish engine families. EPA is concerned that the phasing in of the new standards by power categories, which is intended as an aid to implementation, may actually increase manufacturers' costs without a

[10] "Justification for Amendments to 40 CFR Part 89," EPA memorandum from Greg Orehowsky to Docket A–96–40, August 21, 1997.

significant emissions benefit in the situation where an engine family marginally straddles a power category cutpoint, and therefore must be split. This is especially of concern for Tier 1 engines below 37 kW because of the short lead time provided for the certification of these engines, and because this group is comprised of 3 rather narrow power bands. Therefore, EPA is allowing the creation of Tier 1 engine families that straddle the power band cutpoints at 8, 19, and 37 kW, subject to EPA approval. To avoid potential abuse of this provision by a manufacturer attempting to take advantage of the least stringent emission standards applicable to the engines in the family, such grouping will be allowed only if: (1) most of the engine family's sales in each year are from engines with rated power in the power band with which the engine family is certified, and (2) all power ratings in the engine family that are not within the power band with which the engine family is certified are within 10 percent of one of the two power levels that define this power band. The limitations would not apply if the emission standards for the power band in which the engine family is being certified are at least as stringent as those of the power band that the included engines would otherwise be in. EPA may extend this provision beyond Tier 1 in a future action, but first wishes to examine its effectiveness over time in providing sufficient flexibility without leading to abuse.

The amendments change the criteria for test engine selection. Test engine selection is no longer based on maximum fuel per stroke at maximum power, but is now based primarily on the highest fuel per stroke at peak torque and secondarily on the highest fuel per stroke at rated speed.

The calibration requirements for the gaseous emission measurement analyzers are modified in various ways. The requirements for measurement accuracy below fifteen percent of full scale are revised to include a specific number of gas concentrations at the low end of the calibration curve. Also, calibration requirements are simplified to allow laboratories to calibrate only one analyzer range and still ensure accurate measurements. Additional changes to calibration requirements for other equipment are described in the Summary and Analysis of Comments document.

Other modifications relate to the test sequence and calculation of emission results. A ''mode'' is defined and the procedure for dealing with void modes is included. The equations used to calculate emissions during raw sampling are corrected. The amendments also correct errors in the currently listed equations and include new equations that were mistakenly omitted.

III. 2001 Review and Ensuring Emissions Control In Use

A. 2001 Review

Over the next several years, EPA will be actively engaged in programs to evaluate technology developments and progress toward meeting the new standards. This process will involve engine research programs, coordination with the involved industries, and active interaction with other stakeholders. This effort will culminate in a special review, to be concluded in 2001, to reassess the appropriateness of the Tier 2 standards for engines rated under 37 kW and the Tier 3 standards for engines rated between 37 and 560 kW. The review will also include proposal and adoption of appropriate Tier 3 standards for PM. In addition to reviewing whether or not the new standards are technologically feasible and otherwise appropriate under the Clean Air Act, the Agency will examine the need for equipment redesign due to the new standards and will take appropriate action if significant adverse impacts on the nonroad equipment industry are identified.

Before making a final decision in this review, EPA intends to issue a proposal and offer an opportunity for public comment on whether the standards under review are technologically feasible for implementation according to the proposed schedule, and are otherwise appropriate under the Act. Any changes to certification test procedures or Tier 3 PM standards would also be proposed in that document. Following the close of the comment period, EPA intends to issue a final Agency decision under section 307 of the Act.

If, based on the information collected for the 2001 feasibility review, EPA finds the emission standards are not appropriate under the Act, EPA will propose changes to the program, possibly including adjustments to the levels of the standards. Consistent with the Statement of Principles, the adjusted standards may be more or less stringent than those already established or the schedule could be adjusted. For example, progress to date in the design of low-emitting heavy-duty highway diesel engines has been encouraging, and EPA believes that this progress may benefit designs of large nonroad diesel engines as well, due to the many similarities in these classes of engines. Therefore, the Agency believes that by 2001 it may well be appropriate to consider moving the standards for equal to or greater than 300 horsepower engines forward in time, and so expects to consider this issue in the 2001 feasibility review. Any change to the specified certification test procedure, including the possible adoption of a transient test cycle, will be factored into the evaluation of the appropriateness of the numerical standards. The standards finalized in this document will stay in effect unless revised by subsequent rulemaking procedure.

The review may include other topics as well. Some topics identified in this rulemaking that the Agency plans to review are test fuel sulfur specifications, ABT provisions, Blue Sky Series engine standards, established technologies for deterioration factor determinations, and engine family designations.

B. Ensuring Emissions Control In Use

Key among EPA activities directed toward completing the 2001 feasibility review are those related to adoption of a more effective PM control program for nonroad diesel engines.[11] The establishment of a more effective program will be informed not just by progress in engine designs but also by studies currently being performed by the Agency and by others on the relationship between diesel PM emissions and various health problems.

Establishing an appropriate test cycle is critical to the success of a more effective PM control program. Testing an engine for emissions consists of exercising it over a duty cycle of speeds and loads using an engine dynamometer. The test cycle used to measure emissions should represent operation typical of actual operation in the field. A test procedure that does not

[11] The current control program for PM and all other pollutants includes an emissions standard and related emissions test procedure. For control of PM, as well as other regulated pollutants, an engine may not be equipped with a defeat device, defined as a device, system, or element of design which senses operation outside normal emission test conditions and reduces emission control effectiveness, including any auxiliary emission control device (AECD) that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal operation and use unless the conditions are included in the test procedure (40 CFR 89.107). Manufacturers must provide a detailed description of all auxiliary emissions control devices when they apply for certification (40 CFR 89.115(d)(2)). The defeat device prohibition is designed to ensure that proper control of emission-related engine parameters is maintained during engine operation that is not substantially represented in the certification test cycle. Electronic controls may be considered an AECD, and subject to the defeat device provision.

adequately represent in-use operation might not lead to, on average, the level of control in use set by the emission standards. A test procedure that does reflect real world operating conditions will drive engine designers to develop technologies that achieve in-use control corresponding to the emission standards. EPA has addressed such concerns in the past; for example, the highway heavy-duty engine test cycles were changed to address transient operation (45 FR 4136, January 21, 1980) and, more recently, EPA has revised the test cycle for light-duty vehicles (61 FR 54852, October 22, 1996).

EPA has concerns that the current test cycle does not adequately reflect transient operation, and, therefore, will not lead to the level of average in-use emission control reflected by the PM standard. PM emissions, like NO_X emissions, depend somewhat on engine load characteristics that can be modeled in the steady-state test, but are most sensitive to the degree of transient engine operation. Most nonroad engines are used in applications that are largely transient in nature. Even equipment such as pumps and generators, that operate mostly at constant engine speeds, may depart from steady-state operation due to variation in engine loads over time. EPA believes that the Tier 2 PM emission standards, with the current steady-state test, will produce some degree of in-use emissions control from nonroad engines, especially from engines that typically operate at a constant speed. The level of control from the many nonroad engines that frequently operate in more transient modes, however, is less certain, especially in an engine design era involving stringent PM and NO_X standards and electronic engine controls, as is likely to be the case in Tier 3. Therefore, EPA is moving forward with developing a transient component to the nonroad engine test cycle to control the transient element of PM emissions generation; this component would supplement the steady-state test.

EPA has an additional concern that goes beyond choosing an appropriate test cycle. EPA has observed at times that manufacturers may tailor the design of their engines to narrowly meet the requirements of the emission test. This concern applies not just to PM emissions but to other pollutants such as NO_X and hydrocarbons, as well. The current nonroad test cycle, with a limited combination of steady-state speeds and loads, does not include some of the operating modes that are commonly experienced in the field. In fact, any single prescribed test cycle, although advantageous for test result repeatability and predictability, may not ensure that engine manufacturers design robust emission controls that achieve good control in use. This concern is increased with the advent of electronic controls, which greatly increases the level of sophistication available to manufacturers in controlling emissions levels over the full range of engine operation. To address this and other concerns, in the Tier 1 rulemaking EPA adopted the prohibition on defeat devices (see footnote 11), which the Agency intends to implement for all tiers of standards. EPA may also supplement existing regulations through changes in its nonroad diesel engine program to better control in-use emissions, in a manner that will ensure effective in-use emissions control without unduly increasing manufacturers' testing burden and certification uncertainty.

Although the Agency intends to establish its Tier 3 PM standards and a transient test cycle in the context of the 2001 feasibility review, other activities such as its investigation of in-use operation emissions, including possible regulatory action, may proceed on an earlier schedule. The concerns described above about in-use emissions apply to the pre-Tier 3 as well as the Tier 3 standards, and the Agency believes that prompt action in this area is appropriate. The two efforts discussed above, development of a transient test cycle for PM control and adoption of supplemental measures to better control in-use emissions, have the same overall focus—achieving effective control of emissions in the real world. As a result, the need for a separate transient test cycle may be eliminated if the measures EPA adopts to better control in-use emissions prove adequate for control of PM in use.

IV. Technological Feasibility

The emission standards finalized in this document apply to a broad range of diesel engines used in a wide variety of nonroad applications. Section 213 (a)(3) of the Clean Air Act calls for EPA to establish standards that provide for the "greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the engines or vehicles to which such standards apply, giving appropriate consideration to the cost of applying such technology within the period of time available to manufacturers and to noise, energy, and safety factors associated with the application of such technology." EPA has concluded, as described in the Final RIA, that the new standards will have no significant negative effect on noise, energy, or safety.

Because the emission standards for nonroad diesel engines are based largely on the standards for highway engines and rely on the evaluation of technologies for complying with the standards for highway engines, the discussion of technological feasibility in the highway engine rulemaking is central to supporting the feasibility of the new standards for nonroad engines. This analysis of diesel engine technologies is contained in Chapter 4 of the Final RIA for the highway rulemaking.[12] This analysis is considered and applied to nonroad engines in Chapter 3 of the Final RIA for this rulemaking.

The level and implementation timing of the standards finalized in this document are the most challenging that can be justified. Engine manufacturers will need to use the available lead time to develop the necessary emission control technologies, including transfer of technology from highway engines. This development effort will require not only achieving the targeted emission levels, but also ensuring that each engine will meet all performance and emission requirements over its useful life. The emission standards clearly represent major reductions compared with current emission levels.

Emission control technology for diesel engines is in a period of rapid development in response to the range of emission standards anticipated for the years ahead. This effort will need to continue to meet the requirements of this final rule. However, the emission targets are set in the framework of a long lead time with various flexibility provisions, which provide manufacturers the time they will need to apply emission control technology developments to nonroad engines. Also, the experience gained in response to EPA's emission standards for highway engines will be invaluable in meeting the comparable requirements for nonroad engines. Because the technology development for highway engines will to a large extent constitute basic research of diesel engine combustion, this effort will also benefit manufacturers that produce no highway engines.

On the basis of information currently available, EPA believes that it is feasible for nonroad diesel engine manufacturers

[12] "Final Regulatory Impact Analysis: Control of Emissions of Air Pollution from Highway Heavy-Duty Engines," U.S. EPA, September 16, 1997 (Docket A–95–27).

to meet the standards finalized in this document within the specified time frame, using combinations of the technological approaches discussed in the Final RIA. In addition, EPA believes that the flexibilities incorporated into this final rule will permit nonroad vehicle and equipment manufacturers to respond to engine changes in an orderly way. For both industries, EPA expects that meeting these requirements will pose a significant challenge. As described above, EPA plans to assess, as part of the 2001 feasibility review, the appropriateness of the Tier 3 standards, and the Tier 2 standards for engines rated under 37 kW.

V. Projected Impacts

A. Environmental Impacts

To assess the environmental impact of the new emission standards, EPA has used a draft version of the new NONROAD model, developed by EPA for predicting emissions from nonroad equipment. Chapter 5 of the Final RIA contains a thorough discussion of the methodology used to project the emission inventories and emission reductions from nonroad equipment covered by the new standards. The reader is directed to the RIA for more information on the environmental impact of this final rule.

The amount of growth experienced in the nonroad market will have a significant impact on the emission inventories and emission reductions expected from the new emission standards. For this environmental impact analysis, EPA has examined the impact of the emission standards under two different growth scenarios. (The growth rates used in the nonroad modeling are compounded growth rates.) The first scenario uses growth rates based on information developed by the Bureau of Economic Analysis (BEA). The BEA growth rates, which are prospective, are based on a variety of economic indicators and vary by nonroad segment (i.e., agriculture, construction, etc.). The BEA growth rates typically range from one to two percent per year. Based on trends in historical nonroad equipment sales, trends in nonroad fuel usage, and the continuing strong performance of the U.S. economy, EPA believes that the BEA growth rates may underestimate the future growth of the nonroad market. Therefore, EPA has also modeled the impact of the new standards using information on nonroad equipment population from a database developed by Power Systems Research (PSR). The growth rates based on a retrospective analysis of 1989 to 1996 PSR equipment population data result in typically higher growth rates compared to the BEA information. EPA believes the results from the two growth scenarios serve to bracket the expected environmental impact of the standards. The following discussion of environmental impacts presents the results from both the BEA growth scenario and the PSR growth scenario.

EPA modeled the impact of the new standards for NO_X, NMHC, and PM emissions. The modeling inputs conservatively assume that equipment manufacturers take full advantage of the flexibility provisions described earlier. EPA did not model the impacts of standards on CO because CO emissions from nonroad diesel equipment are a very small portion of the overall CO inventory and the standards are not expected to have a significant impact on CO levels.

Because of the uncertainties about the degree to which the steady-state test procedure will control PM emissions in use, especially from the many nonroad engines that frequently operate in transient modes, EPA cannot be certain that any assessment of expected PM emission reductions made at this time will be completely accurate. Nevertheless, EPA has attempted to make a reasonable estimate of these reductions by assuming that engines will certify at the level of the new emission standards, and applying EPA's best current estimates of adjustment factors for in-use PM emission levels, as reflected in the NONROAD model. These factors and other assumptions in the model are still under review, and will continue to be improved in the future as new information becomes available. The baseline levels used in this analysis are consistent with the position taken in the Tier 1 rule that no PM benefits are claimed from the Tier 1 PM standard. EPA believes that this approach provides a reasonable estimate of PM benefits from the new standards but actual benefits could vary significantly from these levels.

Based on the results of the modeling, the expected emission benefits from the new standards are quite substantial. Tables 4, 5, and 6 contain the nationwide NO_X, NMHC, and PM inventories, respectively, under the baseline scenario, which assumes only the current Tier 1 standards are in effect, and under the control scenario, which assumes the new standards take effect. (The PM reductions contained in Table 6 are direct PM and do not include secondary PM benefits, which are described below.) By 2020, the emission reductions due to the new standards exceed 50 percent for both NO_X and NMHC, and 40 percent for PM. All percentages are calculated relative to the baseline inventories, which assumes only the current Tier 1 standards are in effect.

TABLE 4.—NO_2 EMISSIONS INVENTORY FROM NONROAD DIESEL ENGINES

[Short tons]

Calendar year	PSR growth rates		BEA growth rates	
	With current standards	With new standards	With current standards	With new standards
2000	2,932,000	2,916,000	2,740,000	2,727,000
2010	3,787,000	2,576,000	2,827,000	1,954,000
2020	5,445,000	2,689,000	3,005,000	1,463,000

TABLE 5.—NMHC EMISSIONS INVENTORY FROM NONROAD DIESEL ENGINES

[Short tons]

Calendar year	PSR growth rates		BEA growth rates	
	With current standards	With new standards	With current standards	With new standards
2000	361,000	350,000	337,000	328,000

TABLE 5.—NMHC EMISSIONS INVENTORY FROM NONROAD DIESEL ENGINES—Continued

[Short tons]

Calendar year	PSR growth rates		BEA growth rates	
	With current standards	With new standards	With current standards	With new standards
2010	419,000	256,000	301,000	193,000
2020	619,000	258,000	317,000	138,000

TABLE 6.—PM EMISSIONS INVENTORY FROM NONROAD DIESEL ENGINES

[Short tons]

Calendar year	PSR growth rates		BEA growth rates	
	With current standards	With new standards	With current standards	With new standards
2000	294,000	292,000	271,000	269,000
2010	410,000	270,000	295,000	195,000
2020	604,000	338,000	315,000	170,000

In addition to the effect of the new emission standards on direct PM emissions noted above, the standards are expected to reduce the concentrations of secondary PM. Secondary PM is formed when NO_X reacts with ammonia in the atmosphere to yield ammonium nitrate particulate. Systems Applications International, under contract with EPA, evaluated the effect of the NO_X reductions on the formation of nitrate particulate.[13] The report concluded that, as a national average, each 100 tons of NO_X reduction will result in about 4 tons of secondary PM reduction. This conversion rate varies from region to region, and is greatest in the West. EPA estimates that the approximately 2.8 million tons per year of NO_X reduction projected in 2020 resulting from this final rule (assuming PSR growth rates) will result in a national average of about 110,000 tons per year reduction in secondary PM. This level of secondary PM reduction is equivalent to about 40 percent of the projected direct PM reductions determined from Table 6 (based on PSR growth rates).

As discussed below in section V.B, some technology upgrades associated with this program may have been introduced absent the changes in emission standards. Any emission reductions that would normally have occurred with improvements in technology should not be considered in determining the benefits and cost effectiveness of new emission standards. However, EPA believes that as manufacturers modernize and improve the technologies used on nonroad engines, they are faced with many choices on how to employ the new technologies to the greatest advantage for their customers. Many times, in the absence of requirements to meet tighter emission standards, the manufacturer will design the parameters of a new technology, or similarly, redesign the existing engine, to minimize fuel consumption or some other desirable trait, while not taking advantage of the emissions control capability of the new technology. Because none of these technologies leads to inherently lower emissions, EPA has not made any adjustments to the emission reduction or cost-effectiveness calculations to account for emission benefits that would have occurred independent of the new standards.

B. Economic Impacts

In assessing the economic impact of changing the emission standards, EPA has made a best estimate of the combination of technologies that an engine manufacturer might use to meet the new standards at an acceptable cost. EPA published detailed cost estimates with the proposed rule, which has been extensively revised based on information received during the public comment period. The principal change incorporated into the analysis for the final rule is the inclusion of estimated costs for adding or improving turbocharging and aftercooler systems. The substantial additional costs for these technologies are offset to a great degree by the expected savings from reduced fuel consumption. These and other changes to the estimated economic impact analysis are described in the Summary and Analysis of Comments.

While equipment manufacturers bear no responsibility for meeting emission standards, they will need to make changes in the design of their equipment models to accommodate the new engines. EPA's treatment of the impacts of the new emission standards therefore includes an analysis of costs for equipment manufacturers. Full details of EPA's cost and cost-effectiveness analyses can be found in Chapters 4 and 6 of the Final RIA.

Estimated cost increases are broken into purchase price and total life-cycle operating costs. The incremental purchase price for new engines and equipment is comprised of variable costs (for hardware and assembly time) and fixed costs (for research and development (R&D), retooling, and certification). Total operating costs include any expected increases in maintenance or fuel consumption. Cost estimates based on these projected technology packages represent an expected incremental cost of engines as they begin to comply with new emission standards. Costs in subsequent years are projected to decrease due to several factors, as described below. Separate projected costs were derived for engines and equipment used in six different ranges of rated power; costs were developed for engines near the middle of the listed ranges. All costs are presented in 1995 dollars. Life-cycle costs have been discounted to the year of sale using a discount rate of 7 percent.

1. Engine Technologies

The following discussion provides a brief description of those technologies

[13] "Benefits of Mobile Source NO_X Related Particulate Matter Reductions," Systems Applications International, EPA Contract No. 68–C5–0010, WAN 1–8, October 1996 (available in Air Docket A–96–40).

EPA projects will be needed to comply with the new emission standards. In some cases it is difficult to make a distinction between technologies needed to reduce emissions for compliance with emission standards and those technologies that offer other benefits for improved fuel economy, power density, and other aspects of engine performance. EPA believes that without new emission standards, manufacturers would continue research on and eventually deploy many technological upgrades to improve engine performance or more cost-effectively control emissions. Modifications to fuel injection systems and the introduction of electronic controls are expected to continue, regardless of any change in emission standards, to improve engine performance. Some further development with a focus on NO_X, HC, and PM emissions will nevertheless play an important role in achieving emission reduction targets.

Because several technology upgrades have benefits that go beyond reducing emissions, a difficulty in assessing the impact of new emission standards is establishing the appropriate technology baseline from which to make projections. Ideally, the analysis would establish the mix of technologies that manufacturers would have introduced absent the changes in emission standards, then make a projection for any additional changes in hardware or calibration required to comply with those standards. The costs of those projected technology and calibration changes would then most accurately quantify the impact of setting new emission standards. While it is difficult to take into account the effect of ongoing technology development, EPA believes that assessing the full cost of the anticipated technologies as an impact of the new emission standards would inappropriately exclude from consideration the observed benefits for engine performance, fuel consumption, and durability. Short of having sufficient data to predict the future with a reasonable degree of confidence, EPA faces the need to devise an alternate approach to quantifying the true impact of the new emission standards. EPA believes the observed value of performance improvements in the field justifies the use of a discount based on equal weighting of emission and non-emission benefits of those technologies which clearly have substantial non-emission benefits, namely electronic controls, fuel injection changes, turbocharging, and engine modifications. For some or all of these technologies, a greater value for the non-emission benefits could likely be justified.

A variety of technological improvements are projected for complying with the multiple tiers of new emission standards. Selecting these technology packages requires extensive engineering analysis and judgment. The fact that manufacturers have nearly a full decade before implementation of the most challenging of the new standards ensures that technologies will develop significantly before reaching production. This ongoing development will lead to reduced costs in three ways. First, research will lead to enhanced effectiveness for individual technologies, allowing manufacturers to use simpler packages of emission control technologies than would be predicted given the current state of development. Similarly, the continuing effort to improve the emission control technologies will include innovations that allow lower-cost production. Finally, manufacturers will focus research efforts on any potential drawbacks, such as increased fuel consumption or maintenance costs, attempting to minimize or overcome any negative effects.

A combination of technology upgrades are anticipated as a result of the new emission standards. Modifications to basic engine design features, such as piston bowl shape and engine block and head geometry, can improve intake air characteristics and distribution during combustion. Manufacturers are expected to introduce electronic controls on most engines rated at or above 37 kW. Advanced fuel-injection techniques and hardware will allow designers to modify various fuel injection parameters for higher pressure, further rate shaping, and some split injection. For Tier 3 standards, EPA expects that many engines will see further fuel injection improvements and will incorporate a moderate degree of cooled exhaust gas recirculation. Details of the mix of technologies included in the cost analysis can be found in Chapter 4 of the Final RIA.

While the following analysis projects a relatively uniform emission control strategy for designing the different categories of engines, this should not suggest that EPA expects a single combination of technologies will be used by all manufacturers. In fact, depending on basic engine emission characteristics, EPA expects that control technology packages will gradually be fine-tuned to different applications. Furthermore, EPA expects manufacturers to use averaging, banking, and trading programs as a means to deploy varying degrees of emission control technologies on different engines. EPA nevertheless believes that the projections presented here provide a cost estimate representative of the different approaches manufacturers may ultimately take.

2. Engine Costs

The projected costs of these new technologies for meeting the new standards are itemized in the Final RIA and summarized in Table 7. For the Tier 1 standards for engines rated under 37 kW, estimated costs vary widely. Those engines that already operate with emissions low enough to meet the Tier 1 standards will bear costs only for certifying the engine, or about $10 per engine. For the remaining one-third of engines expected to need reduced emissions, adding engine modifications leads to total costs of around $90. The anticipated increase in operating costs will similarly be focused on the minority of engines that need design improvements, totaling about $130 in net present value (npv) over the lifetime of those engines. The calculated sales-weighted composite increase in both the purchase price and the operating costs for all engines rated under 37 kW is less than $50.

TABLE 7.—PROJECTED UNIT COSTS—ENGINES

Cost category	Year of production	Power (kW)					
		0–37	37–75	75–130	130–450	450–560	560+
Tier 1							
Incremental purchase price	1	$34					
Life-cycle Operating Costs (npv)	All	44					

TABLE 7.—PROJECTED UNIT COSTS—ENGINES—Continued

Cost category	Year of production	Power (kW)					
		0–37	37–75	75–130	130–450	450–560	560+
Tier 2							
Incremental purchase price	1	72	$124	$425	$464	$1,355	$683
Life-cycle Operating Costs (npv)	All	44	59	−147	−262	−1,347	0
Tier 3							
Incremental purchase price	1	....	240	511	758	1,858	....
	6	....	120	297	435	535	....
Life-cycle Operating Costs (npv)	All	....	97	−652	−826	−1,212	....

Tier 2 standards, which apply to the full range of power ratings, involve higher estimated cost impacts. The set of technologies anticipated for Tier 2 engines include varying degrees of engine modifications, improved fuel injection, electronic controls, turbocharging, aftercooling, and exhaust gas recirculation. A small increase in operating costs is expected for engines rated between 37 and 75 kW, but for other engines operating costs are expected to remain unchanged or in some cases to decrease as a result of charge air cooling, as described in the Final RIA. The price of engines rated under 75 kW is expected to increase by about $100. Engines rated between 75 and 450 kW will likely see cost increases between $400 and $500, while larger engines may see price increases approaching or exceeding $1,000. The projected cost of compliance with Tier 3 standards entails increases from Tier 2 costs that follow a similar pattern to the increases for Tier 2 standards, though the Tier 3 standards apply only to engines rated between 37 and 560 kW.

Characterizing these estimated costs in the context of their fraction of the total purchase price and life-cycle operating costs is helpful in gauging the economic impact of the new standards. ICF conducted a study to characterize the range of current engine costs.[14] Although the incremental cost projections in Table 7 increase dramatically with increasing power rating, they in fact represent a comparable price change relative to the total price of the engine. The estimated cost increases for all engines are at most 13 percent of estimated engine prices (after typical discounts and rebates). Moreover, the cost savings described below further reduce the projected impact of the new emission standards; long-term cost increases are expected to be 8 percent of total engine price or less.

For the long term, EPA has identified two principal factors that would cause the estimated incremental costs to decrease over time. First, since fixed costs are assumed to be recovered over a fixed period, these costs disappear from the analysis after they have been fully recovered. This has a most striking effect on the projected costs for engines rated over 450 kW, for which the much higher projected costs are dominated by fixed costs. Second, the analysis incorporates the expectation that manufacturers will apply ongoing research to making emission controls more effective and less costly over time. Research in the costs of manufacturing has consistently shown that as manufacturers gain experience in production, they are able to apply innovations to simplify machining and assembly operations, use lower cost materials, and reduce the number or complexity of component parts.[15] The analysis incorporates the effects of this learning curve by projecting that the variable costs of producing the low-emitting engines decreases by 20 percent starting with the third year of production and by reducing variable costs again by 20 percent starting with the sixth year of production. Table 7 lists the projected costs for each category of engine, including the set of numbers that illustrate the projected reduction in long-term costs for Tier 3 engines.

3. Equipment Costs

In addition to the costs directly associated with engines that are redesigned to meet new standards, costs may also result from the need to redesign the nonroad equipment in which these engines are used. Such redesigns could occur if the engine has a different shape or heat rejection rate, or is no longer made available in the configuration previously used. Based on their experience with the Tier 1 standards set in 1994, equipment manufacturers have told EPA that the main barrier to accommodating complying engines is the late delivery of such engines by engine manufacturers, which cuts into the lead time that equipment manufacturers need to properly redesign their equipment. Thus, attempts were made in developing this rulemaking to provide compliance flexibility to help equipment manufacturers avoid business disruptions resulting from the changes associated with new emission standards.

In addition, the Tier 3 emission standards and implementation dates for engines rated at or above 37 kW and Tier 2 emission standards and implementation dates for engines rated under 37 kW are based on the premise that no significant equipment redesign beyond that required to accommodate engines meeting the previous tier of standards will be required to accommodate the new engines. Equipment manufacturers may, of course, choose to spread equipment redesigning over the time frame for both first and second tiers of standards. This analysis accounts for this flexibility by projecting one major redesign for each equipment model, spreading the costs of this redesign over both tiers of standards. For each tier of standards, EPA projects that equipment manufacturers will have sufficient opportunity to accommodate complying engines and to market their product. EPA will consider the potential for multiple design changes to equipment models during the 2001 Feasibility Review.

In assessing the economic impact of the new emission standards, EPA has made a best estimate of the modifications to equipment that relate

[14] "Engine Price (On-Highway and Nonroad) & Life-cycle Cost Methodology," memorandum from Thomas Uden, ICF, Inc. to Alan Stout, U.S. EPA, March 21, 1997 (available in Air Docket A–96–40).

[15] "Learning Curves in Manufacturing," Linda Argote and Dennis Epple, Science, February 23, 1990, Vol. 247, pp. 920–924 (available in Air Docket A–96–40).

to packaging (installing engines in equipment engine compartments), power train (torque curve), and heat rejection effects of the new complying engines. The incremental purchase price for new engines is comprised of fixed costs (for R&D and retooling) and variable costs (for new or modified components). In its analysis, EPA attributes all changes in operating costs (i.e., additional maintenance and fuel economy benefit or penalty) to the cost estimates for engines. After a new standard takes effect, projected equipment costs in subsequent years would be reduced for the same reasons as described in the engine cost section above. Separate projected costs were determined for equipment using the same ranges of power ratings used above. Full details of EPA's equipment cost analysis can be found in Chapter 4 of the Final RIA.

a. Projected Equipment Changes. As described earlier, the amount of time that an equipment manufacturer has to integrate a new engine into a piece of equipment is of critical importance. These manufacturers have experienced that late engine delivery may prevent them from adequately engineering their equipment designs, resulting in the need for various improvised changes. In this case, the costs associated with the engine change would be for fabricated components and other hardware changes more than for engineering time. In contrast, with adequate lead time, an equipment manufacturer can invest enough engineering time to design around the new engine, usually with minimal increase in hardware costs. Depending on the degree of change required, sales volumes, and other factors, actual costs in either of these scenarios may be comparable. EPA's analysis follows the latter scenario, emphasizing engineering time over hardware costs.

The biggest change anticipated for equipment redesign is in changing the engine compartments to accommodate the physical changes to engines, especially for those engines that add air-to-air aftercoolers. The costs for engine development and the principal hardware components (radiator and plumbing) associated with air-to-air aftercooling are included as costs to the engines, as described above. What remains to be quantified for equipment manufacturers is then the effort to make space for the larger engine system and to integrate the engine into the overall functioning of the equipment. Extensive engineering time is allocated to this effort. In addition, significant costs are included for new, added, or improved materials that may be required, such as brackets, hoses, gaskets, or sheet metal.

b. Projected Equipment Costs. The costs of the projected equipment changes resulting from the new standards are itemized in the Final RIA and summarized in Table 8. For the Tier 1 emission standards that apply to equipment with engines rated under 37 kW, the estimated composite cost increase is $24 per piece of equipment. As described in the section on engine costs above, this estimate is based on the determination that many of the engines for this range of equipment already operate with emissions low enough to meet the Tier 1 standards.

TABLE 8.—PROJECTED UNIT COSTS

Tier	Power (kW)					
	0–37	37–75	75–130	130–450	450–560	560+
TIER 1						
Equipment	$24					
Total Engine and Equipment	59					
TIER 2						
Equipment	8	$125	$441	$340	$1,315	$404
Total Engine and Equipment	80	250	867	804	2,670	1,087
TIER 3: Short-Term						
Equipment		42	147	113	439	
Total Engine and Equipment		282	658	872	2,296	
TIER 3: Long-Term						
Equipment		3	4	5	7	
Total Engine and Equipment		122	301	440	543	

For Tier 2 standards, the relatively low equipment costs for equipment rated under 75 kW reflect the higher sales volume of this range. The highest projected cost of $1315 for equipment utilizing engines rated between 450 and 560 kW demonstrates that high unit equipment costs are due to amortizing large fixed costs over small sales volumes. These large fixed costs result from the effort to accommodate air-to-air aftercooling. Equipment with engines rated over 560 kW are expected to require less redesign, and have correspondingly lower costs, since no changes in aftercooling are anticipated for these models as a result of Tier 2 emission standards.

The projected incremental cost of complying with Tier 3 standards are lower than that for Tier 2 standards, because EPA expects most of the significant changes to equipment designs will occur for Tier 2 standards. For Tier 3 standards, projected equipment costs range from $42 to $439.

As discussed in the section on engine costs above, characterizing both these estimated incremental equipment and engine costs in the context of their fraction of the total equipment purchase price is useful for evaluating the economic impact of the new standards. EPA collected quoted retail (list) prices on several equipment pieces to characterize the range of current equipment prices. The combined incremental costs estimated for equipment and engines together for all power ranges are almost all under 2 percent of list prices, while many are well below 1 percent.

Furthermore, as described in the section on engine costs above, the cost savings from full amortization of fixed costs and application of a learning curve further reduce the projected cost impact of the new standards. Table 8 shows the projected equipment costs for each category of equipment, including the long-term cost projections for complying with Tier 3 standards. The table also presents the combined costs estimated

for equipment and engines (excluding changes to operating costs).

4. Aggregate Costs to Society

The above analysis presents unit cost estimates for each power category. With current data for equipment sales for each category and projections for the future, these costs can be translated into a total projected cost to the nation for the new emission standards in any year. Accounting for the projected favorable impact of the new standards on operating costs, primarily from fuel savings in larger engines, would produce negative aggregate costs (net economic gains) in future years. However, because it is difficult to accurately assess the fuel economy impacts of hardware changes and the degree to which these savings would have developed in the absence of new emission standards, EPA has conservatively chosen to present aggregate costs to society without factoring in the expected changes in operating costs. Using only the increased purchase prices leads to aggregate costs of about $5 million in the first year the new standards apply, increasing to a peak of about $550 million in 2010 as increasing numbers of engines become subject to the new standards. The following years show declining aggregate costs as the per-unit cost of compliance decreases, resulting in a minimum aggregate cost of about $390 million in 2017. After 2017, stable engine costs applied to a slowly growing market lead to slowly increasing aggregate costs.

As described earlier, EPA developed the cost and cost-effectiveness analyses by attributing half of the cost of certain technologies to benefits unrelated to emission control. To analyze the sensitivity of the cost analysis to this assumption, EPA estimated unit costs by attributing the full cost of these technologies to the new emission standards. EPA then estimated the effect of these increased costs on the 20-year costs to society. Assigning the full cost of technology as an to the emission control program, the 20-year fleetwide discounted cost is estimated to be $4.4 billion, approximately $1.2 billion higher than calculated using the base case. Similarly, the resulting 20-year annualized fleetwide costs are $411 million per year, approximately $115 million higher than the base case results.

EPA also developed alternative cost figures to test the sensitivity of distributing fixed costs over worldwide production of nonroad engines and equipment. Because some countries are not expected to adopt harmonized emission standards in the foreseeable future, manufacturers could choose to distribute fixed costs over a subset of foreign sales. Since it is very difficult to quantify sales volumes for individual countries for all the companies that participate in the U.S. market, EPA made the simplifying assumption that fixed costs could be distributed over only half of engines sold into other countries. Distributing costs over this smaller number of engines leads to a 20-year fleetwide discounted cost of $3.6 billion, approximately $0.4 billion higher than the base case results. The corresponding 20-year annualized fleetwide costs are $339 million per year, approximately $40 million higher than the base case results.

C. Cost-Effectiveness

EPA has estimated the cost-effectiveness (i.e., the cost per ton of emission reduction) of the Tier 1, Tier 2 and Tier 3 standards for the same power categories of nonroad equipment highlighted earlier in this section. Chapter 6 of the Final RIA contains a more detailed discussion of the cost-effectiveness analysis.

As described above in the preceding section, the projected cost of complying with the new standards will vary by power category and model year. Therefore, the cost-effectiveness will also vary from model year to model year. For comparison purposes, the discounted costs (including increased engine costs and equipment costs), emission reductions (in short tons), and cost-effectiveness of the NMHC + NO_X standards are shown in Table 9 for the same model years discussed in the preceding section. EPA believes this is a conservative estimate because EPA assumed for the sake of this analysis that all of the increased costs presented earlier were attributable to NMHC + NO_X control and none of the costs were attributed to PM control. NO_X reductions represent approximately 90 percent of the total NMHC + NO_X emission reductions expected from the new standards. In addition, the costs presented in Table 9 do not include the expected effect on operating costs over the lifetime of the equipment. EPA expects the operating costs to offset much, if not all, of the increased engine and equipment costs presented in Table 9 for engines above 75 kW due to expected improvements in fuel economy for engines meeting the new standards.

TABLE 9.—COST-EFFECTIVENESS OF THE NEW NMHC+NO_X STANDARDS

Standard	Power (kW)	Year of production	Discounted engine and equipment cost	Discounted lifetime NMHC+NO_X reductions (tons)	Discounted lifetime cost-effectiveness per ton
Tier 1	0–37	1	$59	0.20	$300
Tier 2	0–37	1	80	0.04	2,090
		6	35		910
	37–75	1	249	0.49	510
	75–130	1	867	1.02	850
	130–450	1	804	1.82	440
	450–560	1	2,670	7.68	350
	>560	1	1,087	9.83	110
		6	1,025		100
Tier 3	37–75	1	282	0.51	560
		6	160		320
	75–130	1	658	0.82	800
		6	442		540
	130–450	1	872	1.46	600
		6	545		380
	450–560	1	2,296	5.91	390
		6	1,991		340

Weighting the projected cost and emission benefit numbers presented above by the populations of the individual power categories, EPA calculated the cost-effectiveness of the new NMHC + NO_X standards for the entire nonroad diesel engine fleet. Table 10 contains the resulting fleet-wide cost-effectiveness results for the Tier 2 and Tier 3 standards. The sensitivity analyses described in Section V.B.4. above would affect cost-effectiveness calculations in the same way as described for fleetwide total costs. The Appendix to the Final RIA includes cost-effectiveness results for the sensitivity analysis in which full costs are attributed to emissions control.

TABLE 10.—FLEET-WIDE COST-EFFECTIVENESS OF THE NEW NONROAD NMHC+NO_X STANDARDS

Standard	Discounted lifetime cost-effectiveness per ton
Tier 2	$600
Tier 3—Short term	650
Tier 3—Long term	410

For comparison to other PM control strategies, EPA has also analyzed the cost-effectiveness of the new standards by very conservatively assuming that half of the increased costs were attributable to PM control. Such a fleet-wide discounted lifetime cost-effectiveness represents the highest figure that could be expected for cost-effectiveness of the new standards and was calculated to provide an indication of the upper bound of PM cost-effectiveness values. The resulting fleet-wide discounted lifetime cost-effectiveness of the Tier 1 and Tier 2 PM standards is approximately $2,300 per ton.

In an effort to evaluate the cost-effectiveness of the NMHC + NO_X controls for nonroad engines, EPA has summarized the cost-effectiveness results for four other recent EPA mobile source rulemakings that required reductions in NO_X (or NMHC + NO_X) emissions. The heavy-duty vehicle portion of the Clean Fuel Fleet Vehicle Program yielded a cost-effectiveness of approximately $1,500/ton of NO_X, Phase II of the Reformulated Gasoline Program yielded approximately $5,000/ton of NO_X, the most recent NMHC + NO_X standards for highway heavy-duty diesel engines yielded a cost-effectiveness of $100–$600/ton of NMHC + NO_X, and the newly adopted standards for locomotive engines yielded a cost-effectiveness of $160–$250/ton of NO_X. The cost-effectiveness of the new NMHC + NO_X standards for nonroad diesel engines presented above are more favorable than the cost-effectiveness of both the clean fuel fleet vehicle program and reformulated gasoline. The cost-effectiveness of the new NMHC + NO_X standards for nonroad diesel engines is comparable to the cost-effectiveness of the most recent NMHC + NO_X standards for heavy-duty highway diesel engines and slightly less favorable than the cost-effectiveness of the locomotive standards.

EPA has also summarized the cost-effectiveness results for two other recent EPA mobile source rulemakings that required reductions in PM emissions. The cost-effectiveness of the most recent urban bus engine PM standard was estimated to be $10,000–$16,000/ton and the cost-effectiveness of the urban bus retrofit/rebuild program was estimated to be approximately $25,000/ton. The PM cost-effectiveness of the new emission standards presented above are more favorable than either of the urban bus programs.

In addition to the benefits of reducing ozone within and transported into urban ozone nonattainment areas, the NO_X reductions from the new standards are expected to have beneficial impacts with respect to crop damage, secondary particulate formation, acid deposition, eutrophication, visibility, and forests, as described earlier. Because of the difficulty of quantifying the monetary value of these societal benefits, the cost-effectiveness values presented do not assign any numerical value to these additional benefits. However, based on an analysis of existing studies that have estimated the value of such benefits in the past, the Agency believes that the actual monetary value of the multiple environmental and public health benefits produced by large NO_X reductions similar to those projected under this final rule will likely be greater than the estimated compliance costs.

VI. Public Participation

A wide variety of interested parties participated in the rulemaking process that culminates with this final rule. This process provided several opportunities for public comment over a period of more than two years. An Advance Notice of Proposed Rulemaking (ANPRM) (60 FR 45580, August 31, 1995) announced EPA's intention to address emissions from nonroad diesel engines, and a Supplemental ANPRM (62 FR 199, January 2, 1997) detailed the framework for a proposed rule. Comments received during this period were considered in the development of the NPRM and are discussed in that document. These comments included information received from small businesses as a part of the multi-agency Small Business Advocacy Review Panel process which was completed prior to the NPRM and is described below under the discussion of the Regulatory Flexibility Act. The formal comment period and public hearing associated with the NPRM provided another opportunity for public input. EPA has also met with a variety of stakeholders at various points in the process, including environmental organizations, engine manufacturers, equipment manufacturers, and states.

EPA has prepared a detailed Summary and Analysis of Comments document which describes the comments received on the NPRM and presents the Agency's response to each of these comments. The Summary and Analysis of Comments document is available in the docket for this rule and on the Office of Mobile Sources internet home page.

VII. Administrative Requirements

A. Administrative Designation and Regulatory Analysis

Under Executive Order 12866, the Agency must assess whether this regulatory action is ''significant'' and therefore subject to Office of Management and Budget (OMB) review and the requirements of the Executive Order (58 FR 51735, Oct. 4, 1993). The order defines ''significant regulatory action'' as any regulatory action that is likely to result in a rule that may:

(1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

(3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or,

(4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

Pursuant to the terms of Executive Order 12866, EPA has determined that this rulemaking is a ''significant regulatory action'' because the new standards and other regulatory provisions, if implemented, are expected to have an annual effect on the economy in excess of $100 million. A

Final RIA has been prepared and is available in the docket associated with this rulemaking. This action was submitted to OMB for review as required by Executive Order 12866. Any written comments from OMB and any EPA response to OMB comments are in the public docket for this rulemaking.

B. Regulatory Flexibility Act

The Regulatory Flexibility Act, 5 U.S.C. 601–612, was amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. 104–121, to ensure that concerns regarding small entities are adequately considered during the development of new regulations that affect them. In response to the provisions of this statute, EPA identified industries that would be subject to this rulemaking and provided information to and received comment from small entities and representatives of small entities in these industries prior to the formal proposal of the program. Small entities submitted written comments on the January, 1997 Supplemental Advance Notice of Proposed Rulemaking and oral comments at an informal workshop in Chicago. From these and other interactions, EPA developed a list of potential provisions that might offer flexibility to small entities while meeting air quality goals.

The Agency convened a Small Business Advocacy Review Panel under section 609(b) of the Regulatory Flexibility Act. The Panel distributed the list of potential flexibility provisions to the identified small entity contacts for further comment and held a teleconference which led to further improvement of the flexibility options. The Panel then received additional written comments on potential options. Based on suggestions from small entities before and after the convening of the Panel, the Panel identified a set of five flexibility provisions to address small business concerns which it recommended to the Agency for proposal in the rule. As detailed in Chapter 4 of the Final RIA, the five recommended provisions were the following: (1) flexibility for equipment manufacturers to aggregate and use exemption allowances on a schedule that best suited their needs, (2) equivalent flexibility for manufacturers of equipment using small engines as for those using larger engines, (3) provision for equipment manufacturers to purchase credits in the averaging, banking, and trading program and to use those credits to exempt more equipment, (4) dropping of the requirement that the small volume allowance be restricted to a single equipment model, and (5) adoption of a hardship relief provision. Subsequently, EPA incorporated all five recommended provisions into the Notice of Proposed Rulemaking. Subsequently, EPA incorporated all five recommended provisions into the Notice of Proposed Rulemaking.

After evaluating additional comments received on the proposed regulatory alternatives, EPA is adopting some of the provisions as they were recommended by the Panel as well as alternative flexibility provisions. The Agency is adopting the first two provisions, although by removing a special broader exemption for farming and logging equipment and instead increasing the allowances available to manufacturers of all types of equipment, the benefit to most small entities will actually be greater than under the proposed program. EPA is also adopting the fifth provision, establishing hardship relief.

The Agency agreed with commenters who said that the third provision, allowing equipment manufacturers to purchase ABT program credits, would not likely provide significant relief to equipment manufacturers while adding the complexity of credit accounting and recordkeeping. This provision was not finalized. The fourth provision was adopted in a revised form, expanding the small volume allowance to multiple equipment models while establishing limitations to prevent widespread use of this provision by larger companies for whom this allowance is not intended.

The Agency believes that, taken as a whole, the flexibility provisions established in this final rule provide small businesses with at least the same and probably greater flexibility compared to the set of provisions recommended by the Panel, while meeting the Agency's air quality goals. These provisions represent a very significant mitigation of the economic impacts on small equipment manufacturers compared to the impacts that might otherwise have occurred if small businesses had not been consulted. The final set of flexibility provisions and EPA's rationale for adopting these provisions are discussed in detail in Section II.E above and in the Summary and Analysis of Comments document.

EPA prepared an Initial Regulatory Flexibility Analysis which analyzed the economic impacts of the proposed rule on small companies and discussed related issues. EPA has now prepared a Final Regulatory Flexibility Analysis, which is incorporated in Chapter 4 (Economic Impact) of the Final Regulatory Impact Analysis associated with this final rule. The Final Regulatory Flexibility Analysis presents the Agency's final assessments of the impacts this rule is likely to have on small entities.

The Final Regulatory Flexibility Analysis incorporates comments received related to the Initial Regulatory Flexibility Analysis and reassesses the impact of the regulations on small entities. As did the Initial document, the Final Regulatory Flexibility Analysis analyzes the four separate but related industries that will be subject to this proposed rule and that contain small businesses as defined by regulations of the Small Business Administration (SBA): nonroad diesel engine manufacturing, manufacturing of nonroad diesel equipment, post-manufacturer marinizing of diesel engines, and the rebuilding or remanufacturing of diesel nonroad engines. A detailed economic analysis was conducted only for equipment manufacturers, for several reasons. First, there is only one manufacturer of diesel engines affected by the proposed rule that meets SBA's small business criteria, and this small engine manufacturer would have impacts from the proposal that are similar to those impacts experienced by large nonroad engine manufacturers as described elsewhere in this final rule. Second, marinizers are expected to experience impacts similar to those of nonroad equipment manufacturers since changes made by the original engine manufacturers might require changes in the parts and process involved in marinization. Finally, engine rebuilders/remanufacturers will not be significantly economically impacted, since the provisions of this final rule for these entities does not require a substantial change to their current practices.

As described above in Section II, this rule includes flexibility provisions for equipment manufacturers (both large and small manufacturers). The Final Regulatory Flexibility Analysis concludes that the final rule, with its compliance flexibility provisions, will result in an estimated 11 percent of small equipment manufacturers having annual compliance costs greater than 1 percent of their sales revenues. Also, an estimated 7 percent of small equipment manufacturers would experience a compliance cost impact greater than 3 percent of sales revenues. EPA believes the effects of the flexibility provisions are conservatively estimated, in part because the hardship relief provisions and the more generous exemption allowances finalized in this rule were not taken into account in the analysis. EPA considers the flexibility provisions

put in place by this rule to be a very effective way of minimizing significant economic impacts on small equipment manufacturers consistent with the Agency's air quality objectives.

C. Paperwork Reduction Act

The Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.*, requires agencies to submit for OMB review and approval, federal requirements and activities that result in the collection of information from ten or more persons. Information collection requirements may include reporting, labeling, and recordkeeping requirements. Federal agencies may not impose penalties on persons who fail to comply with collections of information that do not display a currently valid OMB control number.

The information collection requirements in this final rule have been approved by OMB without comment under the Paperwork Reduction Act, except for the requirement that engine manufacturers' annual reports include information on engines produced for the equipment manufacturer flexibility program, discussed above in section II.E.5. This requirement was not included in the Information Collection Request (ICR) submitted to OMB because it was not formally proposed by EPA in the NPRM. This reporting requirement was, however, put forth in the NPRM for comment, and is being adopted in the final rule based on further analysis and consideration of comments received. EPA plans to submit a separate ICR for this requirement. The following ICR documents have been prepared by EPA:

EPA ICR No.	Title	OMB control No.
0011.09	Selective Enforcement Auditing and recordkeeping requirements for on-highway HDE, nonroad compression ignition engines, and on-highway light-duty vehicles and Light duty trucks.	2060–0604
0095.10	Pre-certification and testing exemption reporting and recordkeeping requirements	2060–0007
0282.10	Emission Defect Information and Voluntary Emission recall reports	2060–0048
1684.04	Compression Ignition Non-Road Engine Certification Application	2060–0104
1695.03	Amendment to the Information Collection Request Emission Standards for New Nonroad Spark-Ignition Engines.	2060–0104
1826.01	Information collection for equipment manufacturer flexibility	2060–0369

The Information Collection Requests (ICR) were subject to public notice and comment prior to OMB approval and, as a result, EPA finds that there is ''good cause'' under section 553(b) of the Administrative Procedures Act (5 U.S.C. 553 (b)) to include these information collection requirements in 40 CFR Part 9 without additional notice and comment. EPA received various comments on the rulemaking provisions covered by the ICRs, but no comments on the paperwork burden or other information in the ICRs. All comments that were submitted to EPA are considered in the Summary and Analysis of Comments, which can be found in the docket (A–96–40). A copy of any of the submitted ICR documents may be obtained from Sandy Farmer, OPPE Regulatory Information Division, U.S. Environmental Protection Agency (2137), 401 M St., S.W., Washington, DC 20460, or by calling (202) 260–2740.

D. Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), Public Law 104–4, establishes requirements for federal agencies to assess the effects of their regulatory actions on state, local, and tribal governments and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with ''federal mandates'' that may result in expenditures to state, local, and tribal governments, in the aggregate, or to the private sector, of $100 million or more for any one year. Before promulgating an EPA rule for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective, or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective, or least burdensome alternative if the Administrator publishes with the final rule an explanation of why that alternative was not adopted. Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

This final rule contains no federal mandates (under the regulatory provisions of Title II of the UMRA) for state, local, or tribal governments. The rule imposes no enforceable duties on any of these governmental entities. Nothing in the final program will significantly or uniquely affect small governments. EPA has determined that this rule contains federal mandates that may result in expenditures of $100 million or more in any one year for the private sector. EPA believes that the proposed program represents the least costly, most cost-effective approach to achieve the air quality goals of the rule. The cost-benefit analysis required by UMRA is contained in the Final RIA. The reader is directed to Section VII.A for further information regarding these analyses.

E. Congressional Review Act

The Congressional Review Act, 5 U.S.C. 801 *et seq.*, as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a rule may take effect, the agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the Congress and to the Comptroller General of the United States. EPA will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives, and the Comptroller General of the United States prior to publication of the rule in the **Federal Register**. This rule is a ''major rule'' as defined by 5 U.S.C. 804(2).

F. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (''NTTAA''), Public Law 104–113, section 12(d) (15 U.S.C. 272

note) directs EPA to use voluntary consensus standards in its regulatory activities unless doing so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This final rule involves technical standards. While commenters suggested the use of ISO 8178 test procedures for measuring emissions, the Agency has decided not to rely on these ISO procedures in this rulemaking. The Agency has determined that these procedures would be impracticable because they rely too heavily on reference testing conditions. Because the test procedures in these regulations need to represent in-use operation typical of operation in the field, they must be based on a range of ambient conditions. EPA has determined that the ISO procedures are not broadly usable in their current form, and therefore cannot be adopted by reference. EPA has instead chosen to continue to rely on the procedures outlined in 40 CFR Part 89. EPA is hopeful that future ISO test procedures will be developed that are usable for the broad range of testing needed, and that such procedures could then be adopted by reference. EPA also expects that any development of revised test procedures will be done in accordance with ISO procedures and in a balanced manner and thus include the opportunity for involvement of a range of interested parties (potentially including parties such as industry, EPA, state governments, and environmental groups) so that the resulting procedures can represent these different interests.

G. Protection of Children

Executive Order 13045, entitled ''Protection of Children from Environmental Health Risks and Safety Risks'' (62 FR 19885, April 23, 1997), applies to a rule that is determined to be ''economically significant,'' as defined under Executive Order 12866, if the environmental health or safety risk addressed by the rule has a disproportionate effect on children. For these rules, the Agency must evaluate the environmental health or safety effects of the planned rule on children; and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency.

This final rule is not subject to Executive Order 13045, because this rule does not involve decisions on environmental health or safety risks that may disproportionately affect children.

H. Enhancing Intergovernmental Partnerships

Under Executive Order 12875, EPA may not issue a regulation that is not required by statute and that creates a mandate upon a State, local or tribal government, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by those governments. If the mandate is unfunded, EPA must provide to the Office of Management and Budget a description of the extent of EPA's prior consultation with representatives of affected State, local and tribal governments, the nature of their concerns, copies of any written communications from the governments, and a statement supporting the need to issue the regulation. In addition, Executive Order 12875 requires EPA to develop an effective process permitting elected officials and other representatives of State, local and tribal governments ''to provide meaningful and timely input in the development of regulatory proposals containing significant unfunded mandates.''

This rule will be implemented at the federal level and imposes compliance obligations only on private industry. The rule thus creates no mandate on State, local or tribal governments, nor does it impose any enforceable duties on these entities. Accordingly, the requirements of Executive Order 12875 do not apply to this rule.

I. Consultation and Coordination With Indian Tribal Governments

Under Executive Order 13084, EPA may not issue a regulation that is not required by statute, that significantly or uniquely affects the communities of Indian tribal governments, and that imposes substantial direct compliance costs on those communities, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by the tribal governments. If the mandate is unfunded, EPA must provide to the Office of Management and Budget, in a separately identified section of the preamble to the rule, a description of the extent of EPA's prior consultation with representatives of affected tribal governments, a summary of the nature of their concerns, and a statement supporting the need to issue the regulation. In addition, Executive Order 13084 requires EPA to develop an effective process permitting elected and other representatives of Indian tribal governments ''to provide meaningful and timely input in the development of regulatory policies on matters that significantly or uniquely affect their communities.''

This rule does not significantly or uniquely affect the communities of Indian tribal governments. As noted above, this rule will be implemented at the federal level and imposes compliance obligations only on private industry. Accordingly, the requirements of Executive Order 13084 do not apply to this rule.

VIII. Statutory Authority

In accordance with section 213(a) of the Clean Air Act, 42 U.S.C. 7547(a), EPA conducted a study of emissions from nonroad engines, vehicles, and equipment in 1991. Based on the results of that study, EPA determined that emissions of NO_X, volatile organic compounds (including hydrocarbons), and CO from nonroad engines and equipment contribute significantly to ozone and CO concentrations in more than one nonattainment area. See 59 FR 31306, June 17, 1994. Given this determination, section 213(a)(3) of the Act requires EPA to promulgate (and from time to time revise) emissions standards for those classes or categories of new nonroad engines, vehicles, and equipment that in EPA's judgment cause or contribute to such air pollution. EPA has determined that the engines regulated under this final rule ''cause or contribute'' to such air pollution. See 59 FR 31306, June 17, 1994.

Where EPA determines that other emissions from new nonroad engines, vehicles, or equipment significantly contribute to air pollution that may reasonably be anticipated to endanger public health or welfare, section 213(a)(4) authorizes EPA to establish (and from time to time revise) emission standards from those classes or categories of new nonroad engines, vehicles, and equipment that EPA determines cause or contribute to such air pollution. In the June 1994 final rule, EPA made this determination for emissions of PM and smoke from nonroad engines in general and for CI nonroad engines rated at or above 37 kW. This rule extends the same findings to nonroad diesel engines rated under 37 kW.

List of Subjects

40 CFR Part 9

Environmental protection, Reporting and recordkeeping requirements.

40 CFR Part 86

Administrative practice and procedure, Confidential business information, Labeling, Motor vehicle pollution, Reporting and recordkeeping requirements.

40 CFR Part 89

Environmental protection, Administrative practice and procedure, Confidential business information, Diesel fuel, Imports, Incorporation by reference, Motor vehicle pollution, Reporting and recordkeeping requirements, Research, Warranties.

Dated: August 27, 1998.

Carol M. Browner,

Administrator.

For the reasons set out in the preamble, title 40, chapter I, parts 9, 86, and 89 of the Code of Federal Regulations are amended as set forth below.

PART 9—[AMENDED]

1. The authority citation for part 9 continues to read as follows:

Authority: 7 U.S.C. 135 *et seq.*, 136–136y; 15 U.S.C. 2001, 2003, 2005, 2006, 2601–2671; 21 U.S.C. 331j, 346a, 348; 31 U.S.C. 9701; 33 U.S.C. 1251 *et seq.*, 1311, 1313d, 1314, 1318, 1321, 1326, 1330, 1342 1344, 1345 (d) and (e), 1361; E.O. 11735, 38 FR 21243, 3 CFR, 1971–1975 Comp. p. 973; 42 U.S.C. 241, 242b, 243, 246, 300f, 300g, 300g–1, 300g–2, 300g–3, 300g–4, 300g–5, 300g–6, 300j–1, 300j–2, 300j–3, 300j–4, 300j–9, 1857 *et seq.*, 6901–6992k, 7401–7671q, 7542, 9601–9657, 11023, 11048.

2. Section 9.1 is amended in the table by removing the center heading ''Control of Emissions From New and In-Use Nonroad Engines'' and the entries under that center heading and adding a new center heading and entries in numerical order to read as follows:

§ 9.1 OMB approvals under the Paperwork Reduction Act.

* * * * *

40 CFR citation	OMB control No.
* * * * *	
Control of Emissions From New and In-Use Nonroad Compression-Ignition Engines	
89.1	2060–0124
89.2	2060–0124
89.114–89.120	2060–0287
89.122–89.127	2060–0287
89.129	2060–0287
89.203–89.207	2060–0287
89.209–89.211	2060–0287
89.304–89.331	2060–0287
89.404–89.424	2060–0287
89.505–89.512	2060–0064
89.603–89.605	2060–0095
89.607–89.610	2060–0095
89.611	2060–0007, 2060–0095
89.612	2060–0095
89.801–89.803	2060–0048
89.903	2060–0124
89.905–89.911	2060–0007

* * * * *

PART 86—CONTROL OF EMISSIONS FROM NEW AND IN-USE HIGHWAY VEHICLES AND ENGINES

3. The heading of part 86 is revised as set forth above.

4. The authority citation for part 86 continues to read as follows:

Authority: 42 U.S.C. 7401–7671(q).

5. Section 86.884–8 is amended by revising the table in paragraph (c)(4) to read as follows:

§ 86.884–8 Dynamometer and engine equipment.

* * * * *

(c) * * *

(4) * * *

Maximum rated horsepower	Exhaust pipe diameter (inches)
HP>50	1.5
50≤HP>100	2.0
100≤HP>200	3.0
200≤HP>300	4.0
300≤HP>500	5.0
HP≤5006.0.	

* * * * *

PART 89—CONTROL OF EMISSIONS FROM NEW AND IN-USE NONROAD COMPRESSION-IGNITION ENGINES

6. The heading of part 89 is revised as set forth above.

7. The authority citation for part 89 continues to read as follows:

Authority: Sections 202, 203, 204, 205, 206, 207, 208, 209, 213, 215, 216, and 301(a) of the Clean Air Act, as amended (42 U.S.C. 7521, 7522, 7523, 7524, 7525, 7541, 7542, 7543, 7547, 7549, 7550, and 7601(a)).

8. The following sections are redesignated as set forth in the following table:

Old designation	New designation
89.101–96	89.101
89.102–96	89.102
89.103–96	89.103
89.104–96	89.104
89.105–96	89.105
89.106–96	89.106
89.107–96	89.107
89.108–96	89.108
89.109–96	89.109
89.110–96	89.110
89.111–96	89.111
89.112–96	89.112
89.113–96	89.113
89.114–96	89.114
89.115–96	89.115
89.116–96	89.116
89.117–96	89.117
89.118–96	89.118
89.119–96	89.119
89.120–96	89.120
89.121–96	89.121
89.122–96	89.122
89.123–96	89.123
89.124–96	89.124
89.125–96	89.125
89.126–96	89.126
89.127–96	89.127
89.128–96	89.128
89.129–96	89.129
89.201–96	89.201
89.202–96	89.202
89.203–96	89.203
89.204–96	89.204
89.205–96	89.205
89.206–96	89.206
89.207–96	89.207
89.208–96	89.208
89.209–96	89.209
89.210–96	89.210
89.211–96	89.211
89.212–96	89.212
89.301–96	89.301
89.302–96	89.302
89.303–96	89.303
89.304–96	89.304
89.305–96	89.305
89.306–96	89.306
89.307–96	89.307
89.308–96	89.308
89.309–96	89.309
89.310–96	89.310
89.311–96	89.311
89.312–96	89.312
89.313–96	89.313
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89.315–96	89.315
89.316–96	89.316
89.317–96	89.317
89.318–96	89.318
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89.327–96	89.327
89.328–96	89.328
89.329–96	89.329
89.330–96	89.330
89.331–96	89.331
89.401–96	89.401
89.402–96	89.402
89.403–96	89.403
89.404–96	89.404
89.405–96	89.405
89.406–96	89.406

Old designation	New designation
89.407–96	89.407
89.408–96	89.408
89.409–96	89.409
89.410–96	89.410
89.411–96	89.411
89.412–96	89.412
89.413–96	89.413
89.414–96	89.414
89.415–96	89.415
89.416–96	89.416
89.417–96	89.417
89.418–96	89.418
89.419–96	89.419
89.420–96	89.420
89.421–96	89.421
89.422–96	89.422
89.423–96	89.423
89.424–96	89.424
89.425–96	89.425
89.501–96	89.501
89.502–96	89.502
89.503–96	89.503
89.504–96	89.504
89.505–96	89.505
89.506–96	89.506
89.507–96	89.507
89.508–96	89.508
89.509–96	89.509
89.510–96	89.510
89.511–96	89.511
89.512–96	89.512
89.513–96	89.513
89.514–96	89.514
89.515–96	89.515
89.516–96	89.516
89.601–96	89.601
89.602–96	89.602
89.603–96	89.603
89.604–96	89.604
89.605–96	89.605
89.606–96	89.606
89.607–96	89.607
89.608–96	89.608
89.609–96	89.609
89.610–96	89.610
89.611–96	89.611
89.612–96	89.612
89.613–96	89.613

9. In part 89, all internal section references are revised as indicated in the above redesignation table.

Subpart A—[Amended]

10. Section 89.1 is amended by revising paragraphs (a) and (b)(4), by removing the word ''and'' at the end of paragraph (b)(3), and adding paragraph (b)(5), to read as follows:

§ 89.1 Applicability.

(a) This part applies to nonroad compression-ignition engines.

(b) * * *

(4) Engines used in marine vessels as defined in the General Provisions of the United States Code, 1 U.S.C. 3 , if those engines have a rated power at or above 37 kW; and

(5) Engines with a per cylinder displacement of less than 50 cubic centimeters.

11. Section 89.2 is amended by revising the definition of Nonroad vehicle or nonroad equipment manufacturer, removing the definition of Nonroad compression-ignition engine and adding new definitions in alphabetical order to read as follows:

§ 89.2 Definitions.

* * * * *

Auxiliary marine diesel engine means a marine diesel engine that is not a propulsion marine diesel engine.

Blue Sky Series engine means a nonroad engine meeting the requirements of § 89.112(f).

* * * * *

Compression-ignition means relating to a type of engine with operating characteristics significantly similar to the theoretical Diesel combustion cycle. The non-use of a throttle to regulate intake air flow for controlling power during normal operation is indicative of a compression-ignition engine. This definition is applicable beginning January 1, 2000.

Constant-speed engine means an engine that is governed to operate only at rated speed.

Crankcase emissions means airborne substances emitted to the atmosphere from any portion of the engine crankcase ventilation or lubrication systems.

* * * * *

Exhaust gas recirculation means an emission control technology that reduces emissions by routing exhaust gases that had been exhausted from the combustion chamber(s) back into the engine to be mixed with incoming air prior to or during combustion. The use of valve timing to increase the amount of residual exhaust gas in the combustion chamber(s) that is mixed with incoming air prior to or during combustion is not considered to be exhaust gas recirculation for the purposes of this part.

* * * * *

Full load governed speed is the maximum full load speed as specified by the manufacturer in the sales and service literature and certification application. This speed is the highest engine speed with an advertised power greater than zero.

* * * * *

Intermediate speed means peak torque speed if peak torque speed occurs from 60 to 75 percent of rated speed. If peak torque speed is less than 60 percent of rated speed, intermediate speed means 60 percent of rated speed. If peak torque speed is greater than 75 percent of rated speed, intermediate speed means 75 percent of rated speed.

Marine diesel engine means a compression-ignition engine that is intended to be installed on a vessel.

* * * * *

Nonroad vehicle or nonroad equipment manufacturer means any person engaged in the manufacturing or assembling of new nonroad vehicles or equipment or importing such vehicles or equipment for resale, or who acts for and is under the control of any such person in connection with the distribution of such vehicles or equipment. A nonroad vehicle or equipment manufacturer does not include any dealer with respect to new nonroad vehicles or equipment received by such person in commerce. A nonroad vehicle or equipment manufacturer does not include any person engaged in the manufacturing or assembling of new nonroad vehicles or equipment who does not install an engine as part of that manufacturing or assembling process. All nonroad vehicle or equipment manufacturing entities that are under the control of the same person are considered to be a single nonroad vehicle or nonroad equipment manufacturer.

* * * * *

Post-manufacture marinizer means a person who produces a marine diesel engine by substantially modifying a certified or uncertified complete or partially complete engine, and is not controlled by the manufacturer of the base engine or by an entity that also controls the manufacturer of the base engine. For the purpose of this definition, ''substantially modify'' means changing an engine in a way that could change engine emission characteristics.

* * * * *

Propulsion marine diesel engine means a marine diesel engine that is intended to move a vessel through the water or direct the movement of a vessel.

Rated speed is the maximum full load governed speed for governed engines and the speed of maximum horsepower for ungoverned engines.

Specific emissions means emissions expressed on the basis of observed brake power, using units of g/kW-hr. Observed brake power measurement includes accessories on the engine if these accessories are required for running an emission test (except for the cooling fan). When it is not possible to test the engine in the gross conditions, for example, if the engine and transmission form a single integral unit, the engine

may be tested in the net condition. Power corrections from net to gross conditions will be allowed with prior approval of the Administrator.

* * * * *

Tier 1 engine means an engine subject to the Tier 1 emission standards listed in § 89.112(a).

Tier 2 engine means an engine subject to the Tier 2 emission standards listed in § 89.112(a).

Tier 3 engine means an engine subject to the Tier 3 emission standards listed in § 89.112(a).

* * * * *

U.S.-directed production volume means the number of nonroad equipment, vehicle, or marine diesel engine units produced by a manufacturer for which the manufacturer has reasonable assurance that sale was or will be made to ultimate purchasers in the United States.

* * * * *

Vessel has the meaning given to it in 1 U.S.C. 3.

12. Section 89.3 is amended by adding new acronyms in alphabetical order to read as follows:

§ 89.3 Acronyms and abbreviations.

* * * * *

EGR Exhaust gas recirculation.

* * * * *

NMHC Nonmethane hydrocarbon.

* * * * *

PM Particulate matter.

* * * * *

THC Total hydrocarbon.

* * * * *

§ 89.4 [Removed and Reserved]

13. Remove and reserve § 89.4.

14. Section 89.6 is amended by revising the last sentence in paragraph (b)(1) introductory text and the table in paragraph (b)(1) to read as follows:

§ 89.6 Reference materials.

* * * * *

(b) * * *

(1) * * * Copies of these materials may be obtained from American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428–2959.

Document number and name	40 CFR part 89 reference
ASTM D86–97:	
''Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure''	Appendix A to Subpart D.
ASTM D93–97:	
''Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester''	Appendix A to Subpart D.
ASTM D129–95:	
''Standard Test Method for Sulfur in Petroleum Products (General Bomb Method)''	Appendix A to Subpart D.
ASTM D287–92:	
''Standard Test Method for API Gravity of Crude Petroleum and Petroleum Products'' (Hydrometer Method)	Appendix A to Subpart D
ASTM D445–97:	
''Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity)''.	Appendix A to Subpart D.
ASTM D613–95:	
''Standard Test Method for Cetane Number of Diesel Fuel Oil''	Appendix A to Subpart D.
ASTM D1319–98:	
''Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption''.	Appendix A to Subpart D.
ASTM D2622–98:	
''Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry''.	Appendix A to Subpart D.
ASTM D5186–96:	
''Standard Test Method for ''Determination of the Aromatic Content and Polynuclear Aromatic Content of Diesel Fuels and Aviation Tubine Fuels By Supercritical Fluid Chromatography''.	Appendix A to Subpart D.
ASTM E29–93a:	
''Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications''	89.120; 89.207; 89.509.

* * * * *

Subpart B—[Amended]

15. The newly designated § 89.102 is amended by revising the section heading and paragraph (a) and adding new paragraphs (c), (d), (e), (f), (g), and (h) to read as follows:

§ 89.102 Effective dates, optional inclusion, flexibility for equipment manufacturers.

(a) This subpart applies to all engines described in § 89.101 with the following power rating and manufactured after the following dates:

(1) Less than 19 kW and manufactured on or after January 1, 2000;

(2) Greater than or equal to 19 kW but less than 37 kW and manufactured on or after January 1, 1999;

(3) Greater than or equal to 37 kW but less than 75 kW and manufactured on or after January 1, 1998;

(4) Greater than or equal to 75 kW but less than 130 kW and manufactured on or after January 1, 1997;

(5) Greater than or equal to 130 kW but less than or equal to 560 kW and manufactured on or after January 1, 1996;

(6) Greater than 560 kW and manufactured on or after January 1, 2000.

* * * * *

(c) Engines meeting the voluntary standards described in § 89.112(f) may be designated as Blue Sky Series engines through the 2004 model year.

(d) *Implementation flexibility for equipment and vehicle manufacturers and post-manufacture marinizers.* Nonroad equipment and vehicle manufacturers and post-manufacture marinizers may take any of the otherwise prohibited actions identified in § 89.1003(a)(1) with respect to nonroad equipment and vehicles and marine diesel engines, subject to the requirements of paragraph (e) of this section. The following allowances apply separately to each engine power category subject to standards under § 89.112:

(1) *Percent-of-production allowances. (i) Equipment rated at or above 37 kW.* For nonroad equipment and vehicles with engines rated at or above 37 kW, a manufacturer may take any of the actions identified in § 89.1003(a)(1) for a portion of its U.S.-directed production volume of such equipment and vehicles during the seven years immediately following the date on which Tier 2 engine standards first apply to engines

used in such equipment and vehicles, provided that the seven-year sum of these portions in each year, as expressed as a percentage for each year, does not exceed 80, and provided that all such equipment and vehicles or equipment contain Tier 1 engines;

(ii) *Equipment rated under 37 kW.* For nonroad equipment and vehicles and marine diesel engines with engines rated under 37 kW, a manufacturer may take any of the actions identified in § 89.1003(a)(1) for a portion of its U.S.-directed production volume of such equipment and vehicles during the seven years immediately following the date on which Tier 1 engine standards first apply to engines used in such equipment and vehicles, provided that the seven-year sum of these portions in each year, as expressed as a percentage for each year, does not exceed 80.

(2) *Small volume allowances.* A nonroad equipment or vehicle manufacturer or post-manufacture marinizer may exceed the production percentages in paragraph (d)(1) of this section, provided that in each regulated power category the manufacturer's total of excepted nonroad equipment and vehicles and marine diesel engines:

(i) Over the years in which the percent-of-production allowance applies does not exceed 100 units times the number of years in which the percent-of-production allowance applies; and

(ii) Does not exceed 200 units in any year; and

(iii) Does not use engines from more than one engine family, or, for excepted equipment vehicles, and marine diesel engines using engines not belonging to any engine family, from more than one engine manufacturer.

(3) *Inclusion of previous-tier engines.* Nonroad equipment and vehicles and marine diesel engines built with previous tier or noncertified engines under the existing inventory provisions of § 89.1003(b)(4) need not be included in determining compliance with paragraphs (d)(1) and (d)(2) of this section.

(e) *Recordkeeping and calculation to verify compliance.* The following shall apply to nonroad equipment or vehicle manufacturers and post-manufacture marinizers who produce excepted equipment or vehicles or marine diesel engines under the provisions of paragraph (d) of this section:

(1) For each power category in which excepted nonroad equipment or vehicles or marine diesel engines are produced, a calculation to verify compliance with the requirements of paragraph (d) of this section shall be made by the nonroad equipment or vehicle manufacturer or post-manufacture marinizer. This calculation shall be made no later than December 31 of the year following the last year in which allowances are used, and shall be based on actual production information from the subject years. If both the percent-of-production and small volume allowances have been exceeded, then the manufacturer is in violation of section 203 of the Act and § 89.1003, except as provided under paragraphs (f) and (h) of this section.

(2) A nonroad equipment or vehicle manufacturer or post-manufacture marinizer shall keep records of all nonroad equipment and vehicles and marine diesel engines excepted under the provisions of paragraph (d) of this section, for each power category in which exceptions are taken. These records shall include equipment and engine model numbers, serial numbers, and dates of manufacture, and engine rated power. In addition, the manufacturer shall keep records sufficient to demonstrate the verifications of compliance required in paragraph (e)(1) of this section. All records shall be kept until at least two full years after the final year in which allowances are available for each power category, and shall be made available to EPA upon request.

(f) *Hardship relief.* Nonroad equipment and vehicle manufacturers and post-manufacture marinizers may take any of the otherwise prohibited actions identified in § 89.1003(a)(1) if approved by the Administrator, and subject to the following requirements:

(1) Application for relief must be submitted to the Engine Programs and Compliance Division of the EPA in writing prior to the earliest date in which the applying manufacturer would be in violation of § 89.1003. The manufacturer must submit evidence showing that the requirements for approval have been met.

(2) The applying manufacturer must not be the manufacturer of the engines used in the equipment for which relief is sought. This requirement does not apply to post-manufacture marinizers.

(3) The conditions causing the impending violation must not be substantially the fault of the applying manufacturer.

(4) The conditions causing the impending violation must be such that the applying manufacturer will experience serious economic hardship if relief is not granted.

(5) The applying manufacturer must demonstrate that no allowances under paragraph (d) of this section will be available to avoid the impending violation.

(6) Any relief granted must begin within one year after the implementation date of the standard applying to the engines being used in the equipment, or to the marine diesel engines, for which relief is requested, and may not exceed one year in duration.

(7) The Administrator may impose other conditions on the granting of relief including provisions to recover the lost environmental benefit.

(g) *Allowance for the production of engines.* Engine manufacturers may take any of the otherwise prohibited actions identified in § 89.1003(a)(1) with regard to uncertified engines or Tier 1 engines, as appropriate, if the engine manufacturer has received written assurance from the equipment manufacturer that the engine is required to meet the demand for engines created under paragraph (d), (f), or (h) of this section.

(h) *Alternative Flexibility for Post-Manufacture Marinizers.* Post-manufacture marinizers may elect to delay the effective date of the Tier 1 standards in § 89.112 for marine diesel engines rated under 37 kW by one year, instead of using the provisions of paragraphs (d) and (f) of this section. Post-manufacture marinizers wishing to take advantage of this provision must inform the Director of the Engine Programs and Compliance Division of their intent to do so in writing before the date that the standards would otherwise take effect.

16. The newly designated § 89.104 is amended by revising paragraphs (a), (b), and (c) to read as follows:

§ 89.104 Useful life, recall, and warranty periods.

(a) The useful life is based on the rated power and rated speed of the engine.

(1) For all engines rated under 19 kW, and for constant speed engines rated under 37 kW with rated speeds greater than or equal to 3,000 rpm, the useful life is a period of 3,000 hours or five years of use, whichever first occurs.

(2) For all other engines rated at or above 19 kW and under 37 kW, the useful life is a period of 5,000 hours or seven years of use, whichever first occurs.

(3) For all engines rated at or above 37 kW, the useful life is a period of 8,000 hours of operation or ten years of use, whichever first occurs.

(b) Engines are subject to recall testing for a period based on the rated power and rated speed of the engines. However, in a recall, engines in the subject class or category would be

subject to recall regardless of actual years or hours of operation.

(1) For all engines rated under 19 kW, and for constant speed engines rated under 37 kW with rated speeds greater than or equal to 3,000 rpm, the engines are subject to recall testing for a period of 2,250 hours or four years of use, whichever first occurs.

(2) For all other engines rated at or above 19 kW and under 37 kW, the engines are subject to recall for a period of 3,750 hours or five years of use, whichever first occurs.

(3) For all engines rated at or above 37 kW, the engines are subject to recall for a period of 6,000 hours of operation or seven years of use, whichever first occurs.

(c) The warranty periods for warranties imposed by the Clean Air Act and § 89.1007 for all engines rated under 19 kW, and for constant speed engines rated under 37 kW with rated speeds greater than or equal to 3,000 rpm, are 1,500 hours of operation or two years of use, whichever first occurs. For all other engines, the warranty periods for warranties imposed by the Clean Air Act and § 89.1007 are 3,000 hours of operation or five years of use, whichever first occurs.

* * * * *

17. The newly designated § 89.109 is revised to read as follows:

§ 89.109 Maintenance instructions and minimum allowable maintenance intervals.

(a) The manufacturer must furnish or cause to be furnished to the ultimate purchaser of each new nonroad engine subject to standards under this part written instructions for the maintenance needed to ensure proper functioning of the emission control system. Paragraphs (b) through (h) of this section do not apply to Tier 1 engines with rated power at or above 37 kW.

(b) Maintenance performed on equipment, engines, subsystems or components used to determine exhaust emission deterioration factors is classified as either emission-related or nonemission-related and each of these can be classified as either scheduled or unscheduled. Further, some emission-related maintenance is also classified as critical emission-related maintenance.

(c) This paragraph (c) specifies emission-related scheduled maintenance for purposes of obtaining durability data for nonroad engines. The maintenance intervals specified below are minimum intervals:

(1) All emission-related scheduled maintenance for purposes of obtaining durability data must occur at the same or longer hours of use intervals as those specified in the manufacturer's maintenance instructions furnished to the ultimate purchaser of the engine under paragraph (a) of this section. This maintenance schedule may be updated as necessary throughout the testing of the engine, provided that no maintenance operation is deleted from the maintenance schedule after the operation has been performed on the test equipment or engine.

(2) Any emission-related maintenance which is performed on equipment, engines, subsystems, or components must be technologically necessary to ensure in-use compliance with the emission standards. The manufacturer must submit data which demonstrate to the Administrator that all of the emission-related scheduled maintenance which is to be performed is technologically necessary. Scheduled maintenance must be approved by the Administrator prior to being performed or being included in the maintenance instructions provided to the purchasers under paragraph (a) of this section.

(i) The Administrator may require longer maintenance intervals than those listed in paragraphs (c)(3) and (c)(4) of this section where the listed intervals are not technologically necessary.

(ii) The Administrator may allow manufacturers to specify shorter maintenance intervals than those listed in paragraphs (c)(3) and (c)(4) of this section where technologically necessary for engines rated under 19 kW, or for constant speed engines rated under 37 kW with rated speeds greater than or equal to 3,000 rpm.

(3) The adjustment, cleaning, repair, or replacement of items listed in paragraphs (c)(3)(i) through (c)(3)(iii) of this section shall occur at 1,500 hours of use and at 1,500-hour intervals thereafter.

(i) Exhaust gas recirculation system-related filters and coolers.

(ii) Positive crankcase ventilation valve.

(iii) Fuel injector tips (cleaning only).

(4) The adjustment, cleaning and repair of items in paragraphs (c)(4)(i) through (c)(4)(vii) of this section shall occur at 3,000 hours of use and at 3,000-hour intervals thereafter for nonroad compression-ignition engines rated under 130 kW, or at 4,500-hour intervals thereafter for nonroad compression-ignition engines rated at or above 130 kW.

(i) Fuel injectors.

(ii) Turbocharger.

(iii) Electronic engine control unit and its associated sensors and actuators.

(iv) Particulate trap or trap-oxidizer system (including related components).

(v) Exhaust gas recirculation system (including all related control valves and tubing) except as otherwise provided in paragraph (c)(3)(i) of this section.

(vi) Catalytic convertor.

(vii) Any other add-on emission-related component (i.e., a component whose sole or primary purpose is to reduce emissions or whose failure will significantly degrade emission control and whose function is not integral to the design and performance of the engine).

(d) Scheduled maintenance not related to emissions which is reasonable and technologically necessary (e.g., oil change, oil filter change, fuel filter change, air filter change, cooling system maintenance, adjustment of idle speed, governor, engine bolt torque, valve lash, injector lash, timing, lubrication of the exhaust manifold heat control valve, etc.) may be performed on durability vehicles at the least frequent intervals recommended by the manufacturer to the ultimate purchaser, (e.g., not the intervals recommended for severe service).

(e) Adjustment of engine idle speed on emission data engines may be performed once before the low-hour emission test point. Any other engine, emission control system, or fuel system adjustment, repair, removal, disassembly, cleaning, or replacement on emission data vehicles shall be performed only with advance approval of the Administrator.

(f) Equipment, instruments, or tools may not be used to identify malfunctioning, maladjusted, or defective engine components unless the same or equivalent equipment, instruments, or tools will be available to dealerships and other service outlets and:

(1) Are used in conjunction with scheduled maintenance on such components; or

(2) Are used subsequent to the identification of a vehicle or engine malfunction, as provided in paragraph (e) of this section for emission data engines; or

(3) Specifically authorized by the Administrator.

(g) All test data, maintenance reports, and required engineering reports shall be compiled and provided to the Administrator in accordance with § 89.124.

(h)(1) The components listed in paragraphs (h)(1)(i) through (h)(1)(vi) of this section are defined as critical emission-related components.

(i) Catalytic converter.

(ii) Electronic engine control unit and its associated sensors and actuators.

(iii) Exhaust gas recirculation system (including all related filters, coolers, control valves, and tubing).

(iv) Positive crankcase ventilation valve.

(v) Particulate trap or trap-oxidizer system.

(vi) Any other add-on emission-related component (i.e., a component whose sole or primary purpose is to reduce emissions or whose failure will significantly degrade emission control and whose function is not integral to the design and performance of the engine).

(2) All critical emission-related scheduled maintenance must have a reasonable likelihood of being performed in use. The manufacturer must show the reasonable likelihood of such maintenance being performed in-use. Critical emission-related scheduled maintenance items which satisfy one of the conditions defined in paragraphs (h)(2)(i) through (h)(2)(vi) of this section will be accepted as having a reasonable likelihood of being performed in use.

(i) Data are presented which establish for the Administrator a connection between emissions and vehicle performance such that as emissions increase due to lack of maintenance, vehicle performance will simultaneously deteriorate to a point unacceptable for typical operation.

(ii) Survey data are submitted which adequately demonstrate to the Administrator with an 80 percent confidence level that 80 percent of such engines already have this critical maintenance item performed in-use at the recommended interval(s).

(iii) A clearly displayed visible signal system approved by the Administrator is installed to alert the equipment operator that maintenance is due. A signal bearing the message ''maintenance needed'' or ''check engine,'' or a similar message approved by the Administrator, shall be actuated at the appropriate usage point or by component failure. This signal must be continuous while the engine is in operation and not be easily eliminated without performance of the required maintenance. Resetting the signal shall be a required step in the maintenance operation. The method for resetting the signal system shall be approved by the Administrator. The system must not be designed to deactivate upon the end of the useful life of the engine or thereafter.

(iv) A manufacturer may desire to demonstrate through a survey that a critical maintenance item is likely to be performed without a visible signal on a maintenance item for which there is no prior in-use experience without the signal. To that end, the manufacturer may in a given model year market up to 200 randomly selected vehicles per critical emission-related maintenance item without such visible signals, and monitor the performance of the critical maintenance item by the owners to show compliance with paragraph (h)(2)(ii) of this section. This option is restricted to two consecutive model years and may not be repeated until any previous survey has been completed. If the critical maintenance involves more than one engine family, the sample will be sales weighted to ensure that it is representative of all the families in question.

(v) The manufacturer provides the maintenance free of charge, and clearly informs the customer that the maintenance is free in the instructions provided under paragraph (a) of this section.

(vi) The manufacturer uses any other method which the Administrator approves as establishing a reasonable likelihood that the critical maintenance will be performed in-use.

(3) Visible signal systems used under paragraph (h)(2)(iii) of this section are considered an element of design of the emission control system. Therefore, disabling, resetting, or otherwise rendering such signals inoperative without also performing the indicated maintenance procedure is a prohibited act.

18. The newly designated § 89.110 is amended by removing ''and'' at the end of paragraph (b)(9), by adding a semicolon at the end of paragraph (b)(10), and by adding new paragraphs (b)(11) and (b)(12) to read as follows:

§ 89.110 Emission control information label.

* * * * *

(b) * * *

(11) Engines belonging to an engine family that has been certified as a constant-speed engine using the test cycle specified in Table 2 of appendix B to subpart E of this part must contain the statement on the label: ''constant-speed only''; and

(12) Engines meeting the voluntary standards described in § 89.112(f)(1) to be designated as Blue Sky Series engines must contain the statement on the label: ''Blue Sky Series''.

* * * * *

19. The newly designated § 89.112 is amended by revising paragraphs (a), (b), and (d), and adding new paragraphs (e) and (f) to read as follows:

§ 89.112 Oxides of nitrogen, carbon monoxide, hydrocarbon, and particulate matter exhaust emission standards.

(a) Exhaust emission from nonroad engines to which this subpart is applicable shall not exceed the applicable exhaust emission standards contained in Table 1, as follows:

BILLING CODE 6560–50–P

Table 1.—Emission Standards (g/kW-hr)

Rated Power (kW)	Tier	Model Year[1]	NOx	HC	NMHC + NOx	CO	PM
kW<8	Tier 1	2000	—	—	10.5	8.0	1.0
	Tier 2	2005	—	—	7.5	8.0	0.80
8≤kW<19	Tier 1	2000	—	—	9.5	6.6	0.80
	Tier 2	2005	—	—	7.5	6.6	0.80
19≤kW<37	Tier 1	1999	—	—	9.5	5.5	0.80
	Tier 2	2004	—	—	7.5	5.5	0.60
37≤kW<75	Tier 1	1998	9.2	—	—	—	—
	Tier 2	2004	—	—	7.5	5.0	0.40
	Tier 3	2008	—	—	4.7	5.0	
75≤kW<130	Tier 1	1997	9.2	—	—	—	—
	Tier 2	2003	—	—	6.6	5.0	0.30
	Tier 3	2007	—	—	4.0	5.0	
130≤kW<225	Tier 1	1996	9.2	1.3	—	11.4	0.54
	Tier 2	2003	—	—	6.6	3.5	0.20
	Tier 3	2006	—	—	4.0	3.5	
225≤kW<450	Tier 1	1996	9.2	1.3	—	11.4	0.54
	Tier 2	2001	—	—	6.4	3.5	0.20
	Tier 3	2006	—	—	4.0	3.5	
450≤kW≤560	Tier 1	1996	9.2	1.3	—	11.4	0.54
	Tier 2	2002	—	—	6.4	3.5	0.20
	Tier 3	2006	—	—	4.0	3.5	
kW>560	Tier 1	2000	9.2	1.3	—	11.4	0.54
	Tier 2	2006	—	—	6.4	3.5	0.20

[1] The model years listed indicate the model years for which the specified tier of standards take effect.

BILLING CODE 6560–50–C

(b) Exhaust emissions of oxides of nitrogen, carbon monoxide, hydrocarbon, and nonmethane hydrocarbon are measured using the procedures set forth in subpart E of this part.

* * * * *

(d) In lieu of the NO_X standards, NMHC + NO_X standards, and PM standards specified in paragraph (a) of this section, manufacturers may elect to include engine families in the averaging, banking, and trading program, the provisions of which are specified in subpart C of this part. The manufacturer must set a family emission limit (FEL) not to exceed the levels contained in Table 2. The FEL established by the manufacturer serves as the standard for that engine family. Table 2 follows:

BILLING CODE 6560–50–P

Table 2.—Upper Limit for Family Emission Limits (g/kW-hr)

Rated Power (kW)	Tier	Model Year[1]	NOx FEL	NMHC+ NOx FEL	PM FEL
kW<8	Tier 1	2000	—	16.0	1.2
	Tier 2	2005	—	10.5	1.0
8≤kW<19	Tier 1	2000	—	16.0	1.2
	Tier 2	2005	—	9.5	0.80
19≤kW<37	Tier 1	1999	—	16.0	1.2
	Tier 2	2004	—	9.5	0.80
37≤kW<75	Tier 1	1998	14.6	—	—
	Tier 2	2004	—	11.5	1.2
	Tier 3	2008	—	7.5	
75≤kW<130	Tier 1	1997	14.6	—	—
	Tier 2	2003	—	11.5	1.2
	Tier 3	2007	—	6.6	
130≤kW<225	Tier 1	1996	14.6	—	—
	Tier 2	2003	—	10.5	0.54
	Tier 3	2006	—	6.6	
225≤kW<450	Tier 1	1996	14.6	—	—
	Tier 2	2001	—	10.5	0.54
	Tier 3	2006	—	6.4	
450≤kW≤560	Tier 1	1996	14.6	—	—
	Tier 2	2002	—	10.5	0.54
	Tier 3	2006	—	6.4	
kW>560	Tier 1	2000	14.6	—	—
	Tier 2	2006	—	10.5	0.54

[1] The model years listed indicate the model years for which the specified tier of limits take effect.

BILLING CODE 6560–50–C

(e) Naturally aspirated nonroad engines to which this subpart is applicable shall not discharge crankcase emissions into the ambient atmosphere, unless such crankcase emissions are permanently routed into the exhaust and included in all exhaust emission measurements. This provision applies to all Tier 2 engines and later models. This provision does not apply to engines using turbochargers, pumps, blowers, or superchargers for air induction.

(f) The following paragraphs define the requirements for low-emitting Blue Sky Series engines:

(1) *Voluntary standards.* Engines may be designated ''Blue Sky Series'' engines through the 2004 model year by meeting the voluntary standards listed in Table 3, which apply to all certification and in-use testing, as follows:

TABLE 3.—VOLUNTARY EMISSION STANDARDS (G/KW-HR)

Rated Brake Power (kW)	$NMHC+NO_X$	PM
kW<8	4.6	0.48
8≤kW<19	4.5	0.48
19≤kW<37	4.5	0.36
37≤kW<75	4.7	0.24
75≤kW<130	4.0	0.18
130≤kW≤560	4.0	0.12
kW>560	3.8	0.12

(2) *Additional standards.* Blue Sky Series engines are subject to all provisions that would otherwise apply under this part, except as specified in paragraph (f)(3) of this section.

(3) *Test procedures.* NO_X, NMHC, and PM emissions are measured using the procedures set forth in 40 CFR part 86, subpart N, in lieu of the procedures set forth in subpart E of this part. CO emissions may be measured using the procedures set forth either in 40 CFR part 86, subpart N, or in Subpart E of this part. Manufacturers may use an alternate procedure to demonstrate the desired level of emission control if approved in advance by the Administrator. Engines meeting the requirements to qualify as Blue Sky Series engines must be capable of maintaining a comparable level of emission control when tested using the procedures set forth in paragraph (c) of this section and subpart E of this part. The numerical emission levels measured using the procedures from subpart E of this part may be up to 20 percent higher than those measured using the procedures from 40 CFR part 86, subpart N, and still be considered comparable.

20. The newly designated § 89.113 is amended by revising paragraph (b) and adding new paragraph (c) to read as follows:

§ 89.113 Smoke emission standard.

* * * * *

(b) Opacity levels are to be measured and calculated as set forth in 40 CFR part 86, subpart I. Notwithstanding the provisions of 40 CFR part 86, subpart I, two-cylinder nonroad engines may be tested using an exhaust muffler that is representative of exhaust mufflers used with the engines in use.

(c) The following engines are exempt from the requirements of this section:

(1) Single-cylinder engines;

(2) Propulsion marine diesel engines; and

(3) Constant-speed engines.

21. The newly designated § 89.114 is amended by revising the section heading, paragraph (a) and the heading of paragraph (b) to read as follows:

§ 89.114 Special and alternate test procedures.

(a) *Special test procedures.* The Administrator may, on the basis of written application by a manufacturer, establish special test procedures other than those set forth in this part, for any nonroad engine that the Administrator determines is not susceptible to satisfactory testing under the specified test procedures set forth in subpart E of this part or 40 CFR part 86, subpart I.

(b) *Alternate test procedures.* * * *

22. The newly designated § 89.116 is amended by adding a new paragraph (e) to read as follows:

§ 89.116 Engine families.

* * * * *

(e)(1) This paragraph (e) applies only to the placement of Tier 1 engines with power ratings under 37 kW into engine families. The provisions of paragraphs (a) through (d) of this section also apply to these engines. The power categories referred to in this paragraph (e) are those for which separate standards or implementation dates are described in § 89.112.

(2) A manufacturer may place engines with power ratings in one power category into an engine family comprised of engines with power ratings in another power category, and consider all engines in the engine family as being in the latter power category for the purpose of determining compliance with the standards and other requirements of this part, subject to approval in advance by the Administrator and the following restrictions:

(i) The engines that have power ratings outside the engine family's power category must constitute less than half of the engine family's sales in each model year for which the engine family grouping is made; and

(ii) The engines that have power ratings outside the engine family's power category must have power ratings that are within ten percent of either of the two power levels that define the engine family's power category.

(3) The restrictions described in paragraphs (e)(2)(i) and (e)(2)(ii) of this section do not apply if the emissions standards and other requirements of this part are at least as stringent for the engine family's power category as those of the other power categories containing engines in the engine family.

23. The newly designated § 89.117 is amended by revising paragraph (a) and adding a new paragraph (d) to read as follows:

§ 89.117 Test fleet selection.

(a) The manufacturer must select for testing, from each engine family, the engine with the most fuel injected per stroke of an injector, primarily at the speed of maximum torque and secondarily at rated speed.

* * * * *

(d) For establishing deterioration factors, the manufacturer shall select the engines, subsystems, or components to be used to determine exhaust emission deterioration factors for each engine-family control system combination. Engines, subsystems, or components shall be selected so that their emission deterioration characteristics are expected to represent those of in-use engines, based on good engineering judgment.

24. The newly designated § 89.118 is amended by revising the section heading and adding new introductory text and a new paragraph (e) to read as follows:

§ 89.118 Deterioration factors and service accumulation.

This section applies to service accumulation used to determine deterioration factors and service accumulation used to condition test engines. Paragraphs (a) and (b) of this section apply only for service accumulation used to condition test engines. Paragraph (e) of this section applies only for service accumulation used to determine deterioration factors. Paragraphs (c) and (d) of this section apply for all service accumulation required by this part.

* * * * *

(e) This paragraph (e) describes service accumulation and alternative requirements for the purpose of developing deterioration factor.

(1) *Service accumulation on engines, subsystems, or components selected by the manufacturer under § 89.117(d).* The manufacturer shall describe the form and extent of this service accumulation in the application for certification.

(2) *Determination of exhaust emission deterioration factors.* The manufacturer shall determine the deterioration factors in accordance with the applicable provisions of this part based on service accumulation and related testing, according to the manufacturer's procedures, except as provided in paragraph (e)(3) of this section.

(3) *Alternatives to service accumulation and testing for the determination of a deterioration factor.* A written explanation of the appropriateness of using an alternative must be included in the application for certification.

(i) *Carryover and carryacross of durability emission data.* In lieu of testing an emission data or durability data engine selected under § 89.117(d), a manufacturer may, with Administrator approval, use exhaust emission deterioration data on a similar engine for which certification to the same standard has previously been obtained or for which all applicable data required under § 89.124 has previously been submitted. This data must be submitted in the application for certification.

(ii) *Use of on-highway deterioration data.* In the case where a manufacturer produces a certified on-highway engine that is similar to the nonroad engine to be certified, deterioration data from the on-highway engine may be applied to the nonroad engine. This application of deterioration data from an on-highway engine to a nonroad engine is subject to Administrator approval, and the determination of whether the engines are similar must be based on good engineering judgment.

(iii) *Engineering analysis for established technologies.* (A) In the case where an engine family uses established technology, an analysis based on good engineering practices may be used in lieu of testing to determine a deterioration factor for that engine family, subject to Administrator approval.

(B) Engines for which the certification levels are not at or below the Tier 3 $NMHC+NO_X$ standards described in § 89.112 are considered established technology, except as provided in paragraph (e)(3)(iii)(D) of this section.

(C) Manufacturers may petition the Administrator to consider an engine with a certification level below the Tier 3 $NMHC+NO_X$ standards as established technology. This petition must be based on proof that the technology used is not significantly different than that used on engines that have certification levels that are not below the Tier 3 $NMHC+NO_X$ levels.

(D) Engines using exhaust gas recirculation or aftertreatment are excluded from the provision set forth in paragraphs (e)(3)(iii)(A) through (e)(3)(iii)(C) of this section.

(E) The manufacturer shall provide a written statement to the Administrator that all data, analyses, test procedures, evaluations, and other documents, on which the deterioration factor is based, are available to the Administrator upon request.

(iv) *Interim provision for engines rated under 37 kW.* For model year 1999 and 2000 engines rated under 37 kW, manufacturers may determine deterioration factors based on good engineering judgement and reasonably available information. The manufacturer must maintain and provide to the Administrator, if requested, all information used to determine deterioration factors for these engines.

25. The newly designated § 89.119 is amended by revising paragraph (d) to read as follows:

§ 89.119 Emission tests.

* * * * *

(d) The provisions of this paragraph (d) apply only to Tier 1 nonroad engines without exhaust aftertreatment rated at or above 37 kW.

(1) Particulate emission measurements from Tier 1 nonroad engines without exhaust aftertreatment rated at or above 37 kW may be adjusted to a sulfur content of 0.05 weight percent.

(2) Adjustments to the particulate measurement shall be made using the following equation:

$$PM_{adj}=PM-[BSFC \times 0.0917 \times (FSF-0.0005)]$$

Where:

PM_{adj}=adjusted measured PM level [g/Kw-hr].

PM=measured weighted PM level [g/Kw-hr].

BSFC=measured brake specific fuel consumption [G/Kw-hr].

FSF=fuel sulfur weight fraction.

(3) Where a manufacturer certifies using test fuel with a sulfur content less than or equal to 0.050 weight percent, EPA shall not use emission data collected using test fuel with a sulfur content greater than 0.050 weight percent to determine compliance with the Tier 1 PM standards.

(4) Where a manufacturer certifies using test fuel with a sulfur content greater than 0.050 weight percent, EPA shall not use emission data collected using test fuel with a sulfur content greater than 0.050 weight percent to determine compliance with the Tier 1 PM standards, unless EPA adjusts the PM measurement using the equation specified in paragraph (d)(2) of this section.

26. The newly designated § 89.120 is amended by revising paragraph (c) and adding paragraph (e) to read as follows:

§ 89.120 Compliance with emission standards.

* * * * *

(c) For each nonroad engine family, except Tier 1 engine families with rated power at or above 37 kW that do not employ aftertreatment, a deterioration factor must be determined and applied.

(1) The applicable exhaust emission standards (or family emission limits, as appropriate) for nonroad compression-ignition engines apply to the emissions of engines for their useful life.

(2) [Reserved]

(3)(i) This paragraph (c)(3) describes the procedure for determining compliance of an engine with emission standards (or family emission limits, as appropriate), based on deterioration factors supplied by the manufacturer. The $NMHC + NO_X$ deterioration factors shall be established based on the sum of the pollutants, except as provided in paragraph (c)(3)(iv) of this section. When establishing deterioration factors for $NMHC + NO_X$, a negative deterioration (emissions decrease from the official emissions test result) for one pollutant may not offset deterioration of the other pollutant.

(ii) Separate emission deterioration factors, determined by the manufacturer according to the requirements of § 89.118, shall be provided in the certification application for each engine-system combination. Separate deterioration factors shall be established for each regulated pollutant, except that a combined $NMHC + NO_X$ deterioration factor shall be established for compression-ignition nonroad engines not utilizing aftertreatment technology. For smoke testing, separate deterioration factors shall also be established for the acceleration mode (designated as ''A''), the lugging mode (designated as ''B''), and peak opacity (designated as ''C'').

(iii) *Compression-ignition nonroad engines not utilizing aftertreatment technology (e.g., particulate traps).* For CO, $NMHC + NO_X$, and particulate, the official exhaust emission results for each emission data engine at the selected test point shall be adjusted by addition of the appropriate deterioration factor. However, if the deterioration factor supplied by the manufacturer is

less than zero, it shall be zero for the purposes of this paragraph (c)(3)(iii).

(iv) *Compression-ignition nonroad engines utilizing aftertreatment technology (e.g., particulate traps).* For CO, NMHC + NO_X, and particulate, the official exhaust emission results for each emission data engine at the selected test point shall be adjusted by multiplication by the appropriate deterioration factor. Separate NMHC and NO_X deterioration factors shall be applied to the results for these pollutants prior to combining the results. If the deterioration factor supplied by the manufacturer is less than one, it shall be one for the purposes of this paragraph (c)(3)(iv).

(v) For acceleration smoke (''A''), lugging smoke (''B''), and peak opacity (''C''), the official exhaust emission results for each emission data engine at the selected test point shall be adjusted by the addition of the appropriate deterioration factor. However if the deterioration supplied by the manufacturer is less than zero, it shall be zero for the purposes of this paragraph (c)(3)(v).

(vi) The emission values to compare with the standards (or family emission limits, as appropriate) shall be the adjusted emission values of paragraphs (c)(3)(iii) through (v) of this section, rounded to the same number of significant figures as contained in the applicable standard in accordance with ASTM E29–93a, for each emission data engine. This procedure has been incorporated by reference at § 89.6.

(4) Every test engine of an engine family must comply with all applicable standards (or family emission limits, as appropriate), as determined in paragraph (c)(3)(vi) of this section, before any engine in that family will be certified.

* * * * *

(e) For the purposes of setting an NMHC + NO_X certification level or FEL, one of the following options shall be used for the determination of NMHC for an engine family. The manufacturer must declare which option is used in its application for certification of that engine family.

(1) The manufacturer may assume that up to two percent of the measured THC is methane (NMHC = $0.98 \times$ THC).

(2) The manufacturer may measure NMHC emissions using a method approved by the Administrator prior to the start of testing. This option allows the determination of NMHC emissions by subtracting measured methane emissions from measured THC emissions.

27. The newly designated § 89.124 is amended by adding paragraph (a)(3) to read as follows:

§ 89.124 Record retention, maintenance, and submission.

(a) * * *

(3) Information required to be kept by the manufacturer in § 89.118(e)(3) for alternatives to service accumulation and testing for the determination of a deterioration factor.

* * * * *

28. The newly designated § 89.125 is amended by revising paragraph (b) to read as follows:

§ 89.125 Production engines, annual report.

* * * * *

(b) The manufacturer must annually, within 30 days after the end of the model year, notify the Administrator of the number of engines produced by engine family, by gross power, by displacement, by fuel system, and, for engines produced under the provision of § 89.102(g), by engine model and purchaser (or shipping destination for engines used by the engine manufacturer), or by other categories as the Administrator may require.

29. The newly designated § 89.126 is amended by revising paragraph (c) to read as follows:

§ 89.126 Denial, revocation of certificate of conformity.

* * * * *

(c) If a manufacturer knowingly commits an infraction specified in paragraph (b)(1) or (b)(4) of this section, knowingly commits any other fraudulent act which results in the issuance of a certificate of conformity, or fails to comply with the conditions specified in § 89.203(d), § 89.206(c), § 89.209(c) or § 89.210(g), the Administrator may deem such certificate void ab initio.

* * * * *

30. A new § 89.130 is added to subpart B to read as follows:

§ 89.130 Rebuild practices.

(a) The provisions of this section are applicable to engines subject to the standards prescribed in § 89.112 and are applicable to the process of engine rebuilding (or rebuilding a portion of an engine or engine system). This section does not apply to Tier 1 engines rated at or above 37 kW. The process of engine rebuilding generally includes disassembly, replacement of multiple parts due to wear, and reassembly, and also may include the removal of the engine from the vehicle and other acts associated with rebuilding an engine.

(b) When rebuilding an engine, portions of an engine, or an engine system, there must be a reasonable technical basis for knowing that the resultant engine is equivalent, from an emissions standpoint, to a certified configuration (i.e., tolerances, calibrations, specifications), and the model year(s) of the resulting engine configuration must be identified. A reasonable basis would exist if:

(1) Parts installed, whether the parts are new, used, or rebuilt, are such that a person familiar with the design and function of motor vehicle engines would reasonably believe that the parts perform the same function with respect to emission control as the original parts; and

(2) Any parameter adjustment or design element change is made only:

(i) In accordance with the original engine manufacturer's instructions; or

(ii) Where data or other reasonable technical basis exists that such parameter adjustment or design element change, when performed on the engine or similar engines, is not expected to adversely affect in-use emissions.

(c) When an engine is being rebuilt and remains installed or is reinstalled in the same equipment, it must be rebuilt to a configuration of the same or later model year as the original engine. When an engine is being replaced, the replacement engine must be an engine of (or rebuilt to) a certified configuration that is equivalent, from an emissions standpoint, to the engine being replaced.

(d) At time of rebuild, emission-related codes or signals from on-board monitoring systems may not be erased or reset without diagnosing and responding appropriately to the diagnostic codes, regardless of whether the systems are installed to satisfy requirements in § 89.109 or for other reasons and regardless of form or interface. Diagnostic systems must be free of all such codes when the rebuilt engine is returned to service. Such signals may not be rendered inoperative during the rebuilding process.

(e) When conducting a rebuild without removing the engine from the equipment, or during the installation of a rebuilt engine, all critical emission-related components listed in 40 CFR part 86, subpart B, not otherwise addressed by paragraphs (b) through (d) of this section must be checked and cleaned, adjusted, repaired, or replaced as necessary, following manufacturer recommended practices.

(f) Records shall be kept by parties conducting activities included in paragraphs (b) through (e) of this section. The records shall include at

minimum the hours of operation at time of rebuild, a listing of work performed on the engine, and emission-related control components including a listing of parts and components used, engine parameter adjustments, emission-related codes or signals responded to and reset, and work performed under paragraph (e) of this section.

(1) Parties may keep records in whatever format or system they choose as long as the records are understandable to an EPA enforcement officer or can be otherwise provided to an EPA enforcement officer in an understandable format when requested.

(2) Parties are not required to keep records of information that is not reasonably available through normal business practices including information on activities not conducted by themselves or information that they cannot reasonably access.

(3) Parties may keep records of their rebuilding practices for an engine family rather than on each individual engine rebuilt in cases where those rebuild practices are followed routinely.

(4) Records must be kept for a minimum of two years after the engine is rebuilt.

Subpart C—[Amended]

31. The newly designated § 89.203 is revised to read as follows:

§ 89.203 General provisions.

(a) The averaging, banking, and trading programs for NO_X, $NMHC+NO_X$, and PM emissions from eligible nonroad engines are described in this subpart. Participation in these programs is voluntary.

(b) *Requirements for Tier 1 engines rated at or above 37 kW.* (1) A nonroad engine family is eligible to participate in the averaging, banking, and trading program for NO_X emissions and the banking and trading program for PM emissions if it is subject to regulation under subpart B of this part with certain exceptions specified in paragraph (b)(2) of this section. No averaging, banking, and trading program is available for meeting the Tier 1 HC, CO, or smoke emission standards specified in subpart B of this part. No averaging program is available for meeting the Tier 1 PM emission standards specified in subpart B of this part.

(2) Nonroad engines may not participate in the averaging, banking, and trading programs if they are exported or are sold as Blue Sky Series engines as described in § 89.112(f). Nonroad engines certified on a special test procedure under § 89.114(a), may not participate in the averaging, banking and trading programs unless the manufacturer has requested that the engines be included in the averaging, banking, and trading programs at the time the request for the special test procedure is made and has been granted approval by the Administrator for inclusion in the averaging, banking, and trading programs.

(3) A manufacturer may certify one or more nonroad engine families at NO_X family emission limits (FELs) above or below the Tier 1 NO_X emission standard, provided the summation of the manufacturer's projected balance of all NO_X credit transactions in a given model year is greater than or equal to zero, as determined under § 89.207(a). A manufacturer may certify one or more nonroad engine families at PM FELs below the Tier 2 PM emission standard that will be applicable to those engine families.

(i) FELs for NO_X may not exceed the Tier 1 upper limit specified in § 89.112(d).

(ii) An engine family certified to an FEL is subject to all provisions specified in this part, except that the applicable FEL replaces the emission standard for the family participating in the averaging, banking, and trading program.

(iii) A manufacturer of an engine family with a NO_X FEL exceeding the Tier 1 NO_X emission standard must obtain NO_X emission credits sufficient to address the associated credit shortfall via averaging, banking, or trading.

(iv) An engine family with a NO_X FEL below the applicable Tier 1 standard may generate emission credits for averaging, banking, trading, or a combination thereof. An engine family with a PM FEL below the Tier 2 standard that will be applicable to that engine family may generate emission credits for banking, trading, or a combination thereof. Emission credits may not be used to offset an engine family's emissions that exceed its applicable FEL. Credits may not be used to remedy nonconformity determined by a Selective Enforcement Audit (SEA) or by recall (in-use) testing. However, in the case of an SEA failure, credits may be used to allow subsequent production of engines for the family in question if the manufacturer elects to recertify to a higher FEL.

(4) NO_X credits generated in a given model year may be used to address credit shortfalls with other engines during that model year or in any subsequent model year except as noted under paragraph (b)(5)(ii) of this section. PM credits may be used to address credit shortfalls with Tier 2 and later engines greater than or equal to 37 kW and Tier 1 and later engines less than 37 kW and greater than or equal to 19 kW. Credits generated in one model year may not be used for prior model years.

(5) The following provisions apply to the use of Tier 1 NO_X credits for showing compliance with the Tier 2 or Tier 3 $NMHC+NO_X$ standards.

(i) A manufacturer may use NO_X credits from engines subject to the Tier 1 NO_X standard to address $NMHC+NO_X$ credit shortfalls with engines in the same averaging set subject to Tier 1 $NMHC+NO_X$ or Tier 2 $NMHC+NO_X$ emission standards.

(ii) A manufacturer may not use NO_X credits from engines subject to the Tier 1 standards to address $NMHC+NO_X$ credit shortfalls with engines subject to the Tier 3 $NMHC+NO_X$ emission standards.

(c) *Requirements for Tier 2 and later engines rated at or above 37 kW and Tier 1 and later engines rated under 37 kW.*

(1) A nonroad engine family is eligible to participate in the averaging, banking, and trading programs for $NMHC+NO_X$ emissions and PM emissions if it is subject to regulation under subpart B of this part with certain exceptions specified in paragraph (c)(2) of this section. No averaging, banking, and trading program is available for meeting the CO or smoke emission standards specified in subpart B of this part.

(2) Nonroad engines may not participate in the averaging, banking, and trading programs if they are exported or are sold as Blue Sky Series engines as described in § 89.112(f). Nonroad engines certified on a special test procedure under § 89.114(a), may not participate in the averaging, banking and trading programs unless the manufacturer has requested that the engines be included in the averaging, banking, and trading programs at the time the request for the special test procedure is made and has been granted approval by the Administrator for inclusion in the averaging, banking, and trading programs.

(3)(i) A manufacturer may certify one or more nonroad engine families at FELs above or below the applicable $NMHC+NO_X$ emission standard and PM emission standard, provided the summation of the manufacturer's projected balance of all $NMHC+NO_X$ credit transactions and the summation of the manufacturer's projected balance of all PM credit transactions in a given model year in a given averaging set is greater than or equal to zero, as determined under § 89.207(b).

(A) FELs for $NMHC+NO_X$ and FELs for PM may not exceed the upper limits specified in § 89.112(d).

(B) An engine family certified to an FEL is subject to all provisions specified in this part, except that the applicable FEL replaces the emission standard for the family participating in the averaging, banking, and trading program.

(C) A manufacturer of an engine family with an FEL exceeding the applicable emission standard must obtain emission credits sufficient to address the associated credit shortfall via averaging, banking, or trading, within the restrictions described in § 89.204(c) and § 89.206(b)(4).

(D) An engine family with an FEL below the applicable standard may generate emission credits for averaging, banking, trading, or a combination thereof. Emission credits may not be used to offset an engine family's emissions that exceed its applicable FEL. Credits may not be used to remedy nonconformity determined by a Selective Enforcement Audit (SEA) or by recall (in-use) testing. However, in the case of an SEA failure, credits may be used to allow subsequent production of engines for the family in question if the manufacturer elects to recertify to a higher FEL.

(ii)(A) In lieu of generating credits under paragraph (c)(3)(i) of this section, a manufacturer may certify one or more nonroad engine families rated under 37 kW at family emission limits (FELs) above or below the applicable NMHC+NO_X emission standard and PM emission standard. The summation of the manufacturer's projected balance of all NMHC+NO_X credit transactions and the summation of the manufacturer's projected balance of all PM credit transactions in a given model year, as determined under § 89.207(b), are each allowed to be less than zero. Separate calculations shall be required for the following two categories of engines: engines rated under 19 kW and engines rated at or above 19 kW and under 37 kW.

(B) For each calendar year a negative credit balance exists as of December 31, a penalty equal to ten percent of the negative credit balance as of December 31 of the calendar year shall be added to the negative credit balance. The resulting negative credit balance shall be carried into the next calendar year.

(C) For engines rated under 19 kW, a manufacturer will be allowed to carry over a negative credit balance until December 31, 2003. For engines rated at or above 19 kW and under 37 kW, a manufacturer will be allowed to carry over a negative credit balance until December 31, 2002. As of these dates, the summation of the manufacturer's projected balance of all NMHC+NO_X credit transactions and the summation of the manufacturer's projected balance of all PM credit transactions must each be greater than or equal to zero.

(D) FELs for NMHC+NO_X and FELs for PM may not exceed the upper limits specified in § 89.112(d).

(E) An engine family certified to an FEL is subject to all provisions specified in this part, except that the applicable NMHC+NO_X FEL or PM FEL replaces the NMHC+NO_X emission standard or PM emission standard for the family participating in the averaging and banking program.

(F) A manufacturer of an engine family with an FEL exceeding the applicable emission standard must obtain emission credits sufficient to address the associated credit shortfall via averaging or banking. The exchange of emission credits generated under this program with other nonroad engine manufacturers in trading is not allowed.

(G) An engine family with an FEL below the applicable standard may generate emission credits for averaging, banking, or a combination thereof. Emission credits may not be used to offset an engine family's emissions that exceed its applicable FEL. Credits may not be used to remedy nonconformity determined by a Selective Enforcement Audit (SEA) or by recall (in-use) testing. However, in the case of an SEA failure, credits may be used to allow subsequent production of engines for the family in question if the manufacturer elects to recertify to a higher FEL.

(4)(i) Except as noted in paragraphs (c)(4)(ii), (c)(4)(iii), and (c)(4)(iv) of this section, credits generated in a given model year may be used during that model year or used in any subsequent model year. Except as allowed under paragraph (c)(3)(ii) of this section, credits generated in one model year may not be used for prior model years.

(ii) Credits generated from engines rated under 19 kW prior to the implementation date of the applicable Tier 2 standards, shall expire on December 31, 2007.

(iii) Credits generated from engines rated under 19 kW under the provisions of paragraph (c)(3)(ii) shall expire on December 31, 2003.

(iv) Credits generated from engines rated at or above 19 kW and under 37 kW under the provisions of paragraph (c)(3)(ii) of this section shall expire on December 31, 2002.

(5) Except as provided in paragraph (b)(3) of this section, engine families may not generate credits for one pollutant while also using credits for another pollutant in the same model year.

(d) Manufacturers must demonstrate compliance under the averaging, banking, and trading programs for a particular model year within 270 days of the end of the model year. Except as allowed under paragraph (c)(3)(ii) of this section, manufacturers that have certified engine families to FELs above the applicable emission standards and do not have sufficient emission credits to offset the difference between the emission standards and the FEL for such engine families will be in violation of the conditions of the certificate of conformity for such engine families. The certificates of conformity may be voided ab initio under § 89.126(c) for those engine families.

32. The newly designated § 89.204 is revised to read as follows:

§ 89.204 Averaging.

(a) *Requirements for Tier 1 engines rated at or above 37 kW.* A manufacturer may use averaging to offset an emission exceedance of a nonroad engine family caused by a NO_X FEL above the applicable emission standard. NO_X credits used in averaging may be obtained from credits generated by another engine family in the same model year, credits banked in a previous model year, or credits obtained through trading.

(b) *Requirements for Tier 2 and later engines rated at or above 37 kW and Tier 1 and later engines rated under 37 kW.* A manufacturer may use averaging to offset an emission exceedance of a nonroad engine family caused by an NMHC+NO_X FEL or a PM FEL above the applicable emission standard. Credits used in averaging may be obtained from credits generated by another engine family in the same model year, credits banked in previous model years that have not expired, or credits obtained through trading. The use of credits shall be within the restrictions described in paragraph (c) of this section, § 89.206(b)(4) and § 89.203(b)(5)(ii).

(c) *Averaging sets for emission credits.* The averaging and trading of NO_X emission credits, NMHC + NO_X emission credits, and PM emissions credits will only be allowed between engine families in the same averaging set. The averaging sets for the averaging and trading of NO_X emission credits, NMHC + NO_X emission credits, and PM emission credits for nonroad engines are defined as follows:

(1) Eligible engines rated at or above 19 kW, other than marine diesel engines, constitute an averaging set.

(2) Eligible engines rated under 19 kW, other than marine diesel engines, constitute an averaging set.

(3) Marine diesel engines rated at or above 19 kW constitute an averaging set. Emission credits generated from marine diesel engines rated at or above 19 kW may be used to address credit shortfalls for eligible engines rated at or above 19 kW other than marine diesel engines.

(4) Marine diesel engines rated under 19 kW constitute an averaging set. Emission credits generated from marine diesel engines rated under 19 kW may be used to address credit shortfalls for eligible engines rated under 19 kW other than marine diesel engines.

33. The newly designated § 89.205 is revised to read as follows:

§ 89.205 Banking.

(a) *Requirements for Tier 1 engines rated at or above 37 kW.* (1) A manufacturer of a nonroad engine family with a NO_X FEL below the applicable standard for a given model year may bank credits in that model year for use in averaging and trading in any subsequent model year.

(2) A manufacturer of a nonroad engine family may bank NO_X credits up to one calendar year prior to the effective date of mandatory certification. Such engines must meet the requirements of subparts A, B, D, E, F, G, H, I, J, and K of this part.

(3)(i) A manufacturer of a nonroad engine family may bank PM credits from Tier 1 engines under the provisions specified in § 89.207(b) for use in averaging and trading in the Tier 2 or later timeframe.

(ii) Such engine families are subject to all provisions specified in subparts A, B, D, E, F, G, H, I, J, and K of this part, except that the applicable PM FEL replaces the PM emission standard for the family participating in the banking and trading program.

(b) *Requirements for Tier 2 and later engines rated at or above 37 kW and Tier 1 and later engines rated under 37 kW.* (1) A manufacturer of a nonroad engine family with an NMHC + NO_X FEL or a PM FEL below the applicable standard for a given model year may bank credits in that model year for use in averaging and trading in any following model year.

(2) For engine rated under 37 kW, a manufacturer of a nonroad engine family may bank credits prior to the effective date of mandatory certification. Such engines must meet the requirements of subparts A, B, D, E, F, G, H, I, J, and K of this part.

(c) A manufacturer may bank actual credits only after the end of the model year and after EPA has reviewed the manufacturer's end-of-year reports. During the model year and before submittal of the end-of-year report, credits originally designated in the certification process for banking will be considered reserved and may be redesignated for trading or averaging in the end-of-year report and final report.

(d) Credits declared for banking from the previous model year that have not been reviewed by EPA may be used in averaging or trading transactions. However, such credits may be revoked at a later time following EPA review of the end-of-year report or any subsequent audit actions.

34. The newly designated § 89.206 is revised to read as follows:

§ 89.206 Trading.

(a) *Requirements for Tier 1 engines rated at or above 37 kW.* (1) A nonroad engine manufacturer may exchange emission credits with other nonroad engine manufacturers within the same averaging set in trading.

(2) Credits for trading can be obtained from credits banked in a previous model year or credits generated during the model year of the trading transaction.

(3) Traded credits can be used for averaging, banking, or further trading transactions within the restrictions described in § 89.204(c).

(b) *Requirements for Tier 2 and later engines rated at or above 37 kW and Tier 1 and later engines rated under 37 kW.* (1) A nonroad engine manufacturer may exchange emission credits with other nonroad engine manufacturers within the same averaging set in trading.

(2) Credits for trading can be obtained from credits banked in previous model years that have not expired or credits generated during the model year of the trading transaction.

(3) Traded credits can be used for averaging, banking, or further trading transactions within the restrictions described in § 89.204(c) and paragraph (b)(4) of this section.

(4) Emission credits generated from engines rated at or above 19 kW utilizing indirect fuel injection may not be traded to other manufacturers.

(c) In the event of a negative credit balance resulting from a transaction, both the buyer and the seller are liable, except in cases deemed involving fraud. Certificates of all engine families participating in a negative trade may be voided ab initio under § 89.126(c).

35. The newly designated § 89.207 is revised to read as follows:

§ 89.207 Credit calculation.

(a) *Requirements for calculating NO_X credits from Tier 1 engines rated at or above 37 kW.* (1) For each participating engine family, emission credits (positive or negative) are to be calculated according to one of the following equations and rounded, in accordance with ASTM E29–93a, to the nearest one-hundredth of a megagram (Mg). This ASTM procedure has been incorporated by reference (see § 89.6). Consistent units are to be used throughout the equation.

(i) For determining credit availability from all engine families generating credits: Emission credits = (Std − FEL) × (Volume) × (AvgPR) × (UL) × (Adjustment) × (10^{-6})

(ii) For determining credit usage for all engine families requiring credits to offset emissions in excess of the standard:

$$\text{Emission credits} = (\text{Std} - \text{FEL}) \times (\text{Volume}) \times (\text{AvgPR}) \times (\text{UL}) \times (10^{-6})$$

Where:

Std = the applicable Tier 1 NO_X nonroad engine emission standard, in grams per kilowatt-hour.

FEL = the NO_X family emission limit for the engine family in grams per kilowatt-hour.

Volume = the number of nonroad engines eligible to participate in the averaging, banking, and trading program within the given engine family during the model year. Engines sold to equipment or vehicle manufacturers under the provisions of § 89.102(g) shall not be included in this number. Quarterly production projections are used for initial certification. Actual applicable production/sales volume is used for end-of-year compliance determination.

AvgPR = the average power rating of all of the configurations within an engine family, calculated on a sales-weighted basis, in kilowatts.

UL = the useful life for the engine family, in hours.

Adjustment = a one-time adjustment, as specified in paragraph (a)(2) of this section, to be applied to Tier 1 NO_X credits to be banked or traded for determining compliance with the Tier 1 NO_X standards or Tier 2 NO_X+NMHC standards specified in subpart B of this part. Banked credits traded in a subsequent model year will not be subject to an additional adjustment. Banked credits used in a subsequent model year's averaging program will not have the adjustment restored.

(2) If an engine family is certified to a NO_X FEL of 8.0 g/kW-hr or less, an Adjustment value of 1.0 shall be used in the credit generation calculation described in paragraph (a)(1)(i) of this section. If an engine family is certified to a NO_X FEL above 8.0 g/kW-hr, an Adjustment value of 0.65 shall be used in the credit generation calculation described in paragraph (a)(1)(i) of this section. If the credits are to be used by the credit-generating manufacturer for averaging purposes in the same model year in which they are generated, an Adjustment value of 1.0 shall be used for all engines regardless of the level of

the NO_X FEL. If the credits are to be banked by the credit-generating manufacturer and used in a subsequent model year for another Tier 1 engine family, an Adjustment value of 1.0 shall be used for all engines regardless of the level of the NO_X FEL.

(b) *Requirements for calculating NMHC + NO_X Credits from Tier 2 and later engines rated at or above 37 kW and Tier 1 and later engines rated under 37 kW and PM credits from all engines.* (1) For each participating engine family, NO_X + NMHC emission credits and PM emission credits (positive or negative) are to be calculated according to one of the following equations and rounded, in accordance with ASTM E29–93a, to the nearest one-hundredth of a megagram (Mg). This procedure has been incorporated by reference (see § 89.6). Consistent units are to be used throughout the equation.

(i) For determining credit availability from all engine families generating credits:

Emission credits = (Std-FEL) x (Volume) x (AvgPR) x (UL) x (10^{-6})

(ii) For determining credit usage for all engine families requiring credits to offset emissions in excess of the standard:

Emission credits = (Std-FEL) x (Volume) x (AvgPR) x (UL) x (10^{-6})

Where:

Std = the current and applicable nonroad engine emission standard, in grams per kilowatt-hour, except for PM calculations where it is the applicable nonroad engine Tier 2 PM emission standard, and except for engines rated under 19 kW where it is the applicable nonroad engine Tier 2 emission standard, in grams per kilowatt-hour. (Engines rated under 19 kW participating in the averaging and banking program provisions of § 89.203(c)(3)(ii) shall use the Tier 1 standard for credit calculations.)

FEL = the family emission limit for the engine family in grams per kilowatt-hour.

Volume = the number of nonroad engines eligible to participate in the averaging, banking, and trading program within the given engine family during the model year. Engines sold to equipment or vehicle manufacturers under the provisions of § 89.102(g) shall not be included in this number. Quarterly production projections are used for initial certification. Actual applicable production/sales volume is used for end-of-year compliance determination.

AvgPR = the average power rating of all of the configurations within an engine family, calculated on a sales-weighted basis, in kilowatts.

UL = the useful life for the given engine family, in hours.

36. The newly designated § 89.208 is revised to read as follows:

§ 89.208 Labeling.

For all nonroad engines included in the averaging, banking, and trading programs, the family emission limits to which the engine is certified must be included on the label required in § 89.110.

37. The newly designated § 89.209 is amended by revising paragraph (a) to read as follows:

§ 89.209 Certification.

(a) In the application for certification a manufacturer must:

(1) Declare its intent to include specific engine families in the averaging, banking, and trading programs.

(2) Submit a statement that the engines for which certification is requested will not, to the best of the manufacturer's belief, cause the manufacturer to have a negative credit balance when all credits are calculated for all the manufacturer's engine families participating in the averaging, banking, and trading programs, except as allowed under § 89.203(c)(3)(ii).

(3) Declare the applicable FELs for each engine family participating in averaging, banking, and trading.

(i) The FELs must be to the same number of significant digits as the emission standard for the applicable pollutant.

(ii) In no case may the FEL exceed the upper limits prescribed in § 89.112(d).

(4) Indicate the projected number of credits generated/needed for this family; the projected applicable production/sales volume, by quarter; and the values required to calculate credits as given in § 89.207.

(5) Submit calculations in accordance with § 89.207 of projected emission credits (positive or negative) based on quarterly production projections for each participating family.

(6)(i) If the engine family is projected to have negative emission credits, state specifically the source (manufacturer/engine family or reserved) of the credits necessary to offset the credit deficit according to quarterly projected production, or, if the engine family is to be included in the provisions of § 89.203(c)(3)(ii), state that the engine family will be subject to those provisions.

(ii) If the engine family is projected to generate credits, state specifically (manufacturer/engine family or reserved) where the quarterly projected credits will be applied.

* * * * *

38. The newly designated § 89.210 is amended by revising paragraphs (b) and (c) to read as follows:

§ 89.210 Maintenance of records.

* * * * *

(b) The manufacturer of any nonroad engine family that is certified under the averaging, banking, and trading programs must establish, maintain, and retain the following adequately organized and indexed records for each such family:

(1) EPA engine family;

(2) Family emission limits (FEL);

(3) Power rating for each configuration tested;

(4) Projected applicable production/sales volume for the model year; and

(5) Actual applicable production/sales volume for the model year.

(c) Any manufacturer producing an engine family participating in trading reserved credits must maintain the following records on a quarterly basis for each engine family in the trading program:

(1) The engine family;

(2) The actual quarterly and cumulative applicable production/sales volume;

(3) The values required to calculate credits as given in § 89.207;

(4) The resulting type and number of credits generated/required;

(5) How and where credit surpluses are dispersed; and

(6) How and through what means credit deficits are met.

* * * * *

39. The newly designated § 89.211 is amended by revising paragraphs (a) and (c) to read as follows:

§ 89.211 End-of-year and final reports.

(a) End-of-year and final reports must indicate the engine family, the actual applicable production/sales volume, the values required to calculate credits as given in § 89.207, and the number of credits generated/required. Manufacturers must also submit how and where credit surpluses were dispersed (or are to be banked) and/or how and through what means credit deficits were met. Copies of contracts related to credit trading must be included or supplied by the broker, if applicable. The report shall include a calculation of credit balances to show that the summation of the manufacturer's use of credits results in a credit balance equal to or greater than zero, except as allowed under § 89.203(c)(3)(ii). Manufacturers participating under the program

described in § 89.203(c)(3)(ii) shall include the NMHC + NO_X credit balance and the PM credit balance as of December 31 of that calendar year.

* * * * *

(c)(1) End-of-year reports must be submitted within 90 days of the end of the model year to: Director, Engine Programs and Compliance Division (6405-J), U.S. Environmental Protection Agency, 401 M Street S.W., Washington, DC 20460.

(2) Final reports must be submitted within 270 days of the end of the model year to: Director, Engine Programs and Compliance Division (6405-J), U.S. Environmental Protection Agency, 401 M Street S.W., Washington, DC 20460.

* * * * *

40. The newly designated § 89.212 is revised to read as follows:

§ 89.212 Notice of opportunity for hearing.

Any voiding of the certificate under §§ 89.203(d), 89.206(c), 89.209(c) or 89.210(g) will be made only after the manufacturer concerned has been offered an opportunity for a hearing conducted in accordance with §§ 89.512 and 89.513 and, if a manufacturer requests such a hearing, will be made only after an initial decision by the Presiding Officer.

Subpart D—[Amended]

41. The newly designated § 89.302 is revised to read as follows:

§ 89.302 Definitions.

The definitions in subpart A of this part apply to this subpart. For terms not defined in this part, the definitions in 40 CFR part 86, subparts A, D, I, and N, apply to this subpart.

42. The newly designated § 89.304 is amended by revising paragraph (c) to read as follows:

§ 89.304 Equipment required for gaseous emissions; overview.

* * * * *

(c) Analyzers used are a non-dispersive infrared (NDIR) absorption type for carbon monoxide and carbon dioxide analysis; a heated flame ionization (HFID) type for hydrocarbon analysis; and a chemiluminescent detector (CLD) or heated chemiluminescent detector (HCLD) for oxides of nitrogen analysis. Sections 89.309 through 89.324 set forth a full description of analyzer requirements and specifications.

43. The newly designated § 89.307 is amended by revising paragraphs (b)(7) and (b)(8) to read as follows:

§ 89.307 Dynamometer calibration.

* * * * *

(b) * * *

(7) The measured torque must be within either 2 percent of point or 1 percent of the engine maximum torque of the calculated torque.

(8) If the measured torque is not within the above requirements, adjust or repair the system. Repeat steps in paragraphs (b)(1) through (b)(6) of this section with the adjusted or repaired system.

* * * * *

44. The newly designated § 89.308 is amended by revising paragraph (b) to read as follows:

§ 89.308 Sampling system requirements for gaseous emissions.

* * * * *

(b) If water is removed by condensation, the sample gas temperature shall be monitored within the water trap or the sample dewpoint shall be monitored downstream. In either case, the indicated temperature shall not exceed 7°C.

45. The newly designated § 89.309 is amended by removing and reserving paragraph (a)(3) and revising paragraphs (a)(4)(iii), (a)(5)(i)(C), and (a)(5)(i)(D) to read as follows:

§ 89.309 Analyzers required for gaseous emissions.

(a) * * *

(3) [Reserved]

(4) * * *

(iii) The FID oven must be capable of maintaining temperature within 5.5°C of the set point.

* * * * *

(5) * * *

(i) * * *

(C) For raw analysis, an ice bath or other cooling device located after the NO_X converter (optional for dilute analysis).

(D) A chemiluminescent detector (CLD or HCLD).

* * * * *

46. The newly designated § 89.310 is amended by revising paragraphs (a)(1) and (c) to read as follows:

§ 89.310 Analyzer accuracy and specifications.

(a) * * *

(1) *Response time.* As necessary, measure and account for the response time of the analyzer.

* * * * *

(c) *Emission measurement accuracy—Bag sampling.* (1) Good engineering practice dictates that exhaust emission sample analyzer readings below 15 percent of full-scale chart deflection should generally not be used.

(2) Some high resolution read-out systems, such as computers, data loggers, and so forth, can provide sufficient accuracy and resolution below 15 percent of full scale. Such systems may be used provided that additional calibrations of at least 4 non-zero nominally equally spaced points, using good engineering judgement, below 15 percent of full scale are made to ensure the accuracy of the calibration curves. If a gas divider is used, the gas divider must conform to the accuracy requirements specified in § 89.312(c). The procedure in paragraph (c)(3) of this section may be used for calibration below 15 percent of full scale.

(3) The following procedure shall be followed:

(i) Span the analyzer using a calibration gas meeting the accuracy requirements of § 89.312(c), within the operating range of the analyzer, and at least 90% of full scale.

(ii) Generate a calibration over the full concentration range at a minimum of 6, approximately equally spaced, points (e.g. 15, 30, 45, 60, 75, and 90 percent of the range of concentrations provided by the gas divider). If a gas divider or blender is being used to calibrate the analyzer and the requirements of paragraph (c)(2) of this section are met, verify that a second calibration gas between 10 and 20 percent of full scale can be named within 2 percent of its certified concentration.

(iii) If a gas divider or blender is being used to calibrate the analyzer, input the value of a second calibration gas (a span gas may be used for the CO2 analyzer) having a named concentration between 10 and 20 percent of full scale. This gas shall be included on the calibration curve. Continue adding calibration points by dividing this gas until the requirements of paragraph (c)(2) of this section are met.

(iv) Fit a calibration curve per § 89.319 through § 89.322 for the full scale range of the analyzer using the calibration data obtained with both calibration gases.

* * * * *

47. The newly designated § 89.312 is amended by removing and reserving paragraph (b)(2), revising paragraphs (c)(2), (d), and (f) and adding a new paragraph (g) to read as follows:

§ 89.312 Analytical gases.

* * * * *

(b) * * *

(2) [Reserved].

(c) * * *

(2) Mixtures of gases having the following chemical compositions shall be available:

(i) C_3H_8 and purified synthetic air ;

(ii) C_3H_8 and purified nitrogen (optional for raw measurements);

(iii) CO and purified nitrogen;

(iv) NO_X and purified nitrogen (the amount of NO_2 contained in this calibration gas must not exceed 5 percent of the NO content);

(v) CO_2 and purified nitrogen.

* * * * *

(d) Oxygen interference check gases shall contain propane with 350 ppmC ±75 ppmC hydrocarbon. The three oxygen interference gases shall contain 21% ± 1% O_2, 10% ± 1% O_2, and 5% ± 1% O_2. The concentration value shall be determined to calibration gas tolerances by chromatographic analysis of total hydrocarbons plus impurities or by dynamic blending. Nitrogen shall be the predominant diluent with the balance oxygen.

* * * * *

(f) Hydrocarbon analyzer burner air. The concentration of oxygen for raw sampling must be within 1 mole percent of the oxygen concentration of the burner air used in the latest oxygen interference check (%O_2I). If the difference in oxygen concentration is greater than 1 mole percent, then the oxygen interference must be checked and, if necessary, the analyzer adjusted to meet the %O_2I requirements. The burner air must contain less than 2 ppmC hydrocarbon.

(g) Gases for the methane analyzer shall be single blends of methane using air as the diluent.

48. The newly designated § 89.314 is amended by revising paragraphs (a) and (b) to read as follows:

§ 89.314 Pre-and post-test calibration of analyzers.

* * * * *

(a) The calibration is checked by using a zero gas and a span gas whose nominal value is between 75 percent and 100 percent of full-scale, inclusive, of the measuring range.

(b) After the end of the final mode, a zero gas and the same span gas will be used for rechecking. As an option, the zero and span may be rechecked at the end of each mode or each test segment. The analysis will be considered acceptable if the difference between the two measuring results is less than 2 percent of full scale.

§ 89.316 [Amended]

49. The newly designated § 89.316 is amended by removing and reserving paragraph (b).

50. The newly designated § 89.317 is amended by revising paragraphs (g), (h), and (k) to read as follows:

§ 89.317 NO_X converter check.

* * * * *

(g) Turn on the NO_X generator O_2 (or air) supply and adjust the O_2 (or air) flow rate so that the NO indicated by the analyzer is about 10 percent less than indicated in paragraph (f) of this section. Record the concentration of NO in this NO+O_2 mixture.

(h) Switch the NO_X generator to the generation mode and adjust the generation rate so that the NO measured on the analyzer is 20 percent of that measured in paragraph (f) of this section. There must be at least 10 percent unreacted NO at this point. Record the concentration of residual NO.

* * * * *

(k) Turn off the NO_X generator O_2 (or air) supply. The analyzer will now indicate the NO_X in the original NO-in-N_2 mixture. This value should be no more than 5 percent above the value indicated in paragraph (f) of this section.

* * * * *

51. The newly designated § 89.318 is amended by revising paragraphs (c)(2) heading, (c)(2)(i) and (c)(2)(iv) to read as follows:

§ 89.318 Analyzer interference checks.

* * * * *

(c) * * *

(2) *NO_x analyzer water quench check.* (i) This check applies to wet measurements only. An NO span gas having a concentration of 80 to 100 percent of full scale of a normal operating range shall be passed through the CLD (or HCLD) and the response recorded as D. The NO span gas shall then be bubbled through water at room temperature and passed through the CLD (or HCLD) and the analyzer response recorded as AR. Determine and record the bubbler absolute operating pressure and the bubbler water temperature. (It is important that the NO span gas contains minimal NO_2 concentration for this check. No allowance for absorption of NO_2 in water has been made in the following quench calculations. This test may be optionally run in the NO mode to minimize the effect of any NO_2 in the NO span gas.)

* * * * *

(iv)(A) The maximum raw or dilute exhaust water vapor concentration expected during testing (designated as Wm) can be estimated from the CO_2 span gas (or as defined in the equation in this paragraph and designated as A) criteria in paragraph (c)(1) of this section and the assumption of a fuel atom H/C ratio of 1.8:1 as:

$$Wm(\%)=0.9\times A(\%)$$

Where:

A = maximum CO2 concentration expected in the sample system during testing.

(B) Percent water quench shall not exceed 3 percent and shall be calculated by:

$$\%\text{Water Quench} = 100 \times \frac{\text{D1}-\text{AR}}{\text{D1}} \times \frac{\text{Wm}}{\text{Z1}}$$

52. The newly designated § 89.319 is amended by revising paragraphs (b)(1), (b)(2), (c), (d) heading, (d) introductory text, (d)(2), and (d)(6) to read as follows:

§ 89.319 Hydrocarbon analyzer calibration.

* * * * *

(b) * * *

(1) Follow good engineering practices for initial instrument start-up and basic operating adjustment using the appropriate fuel (see § 89.312(e)) and zero-grade air.

(2) Optimize the FID's response on the most common operating range. The response is to be optimized with respect to fuel pressure or flow. Efforts shall be made to minimize response variations to different hydrocarbon species that are expected to be in the exhaust. Good engineering judgment is to be used to trade off optimal FID response to propane-in-air against reductions in relative responses to other hydrocarbons. A good example of trading off response on propane for relative responses to other hydrocarbon species is given in Society of Automotive Engineers (SAE) Paper No. 770141, ''Optimization of Flame Ionization Detector for Determination of Hydrocarbon in Diluted Automotive Exhausts''; author Glenn D. Reschke. It is also required that the response be set to optimum condition with respect to air flow and sample flow. Heated Flame Ionization Detectors (HFIDs) must be at their specified operating temperature. One of the following procedures is required for FID or HFID optimization:

(i) The procedure outlined in Society of Automotive Engineers (SAE) paper No. 770141, ''Optimization of a Flame Ionization Detector for Determination of Hydrocarbon in Diluted Automotive Exhausts''; author, Glenn D. Reschke. This procedure has been incorporated by reference at § 89.6.

(ii) The HFID optimization procedures outlined in 40 CFR part 86, subpart D.

(iii) Alternative procedures may be used if approved in advance by the Administrator.

(iv) The procedures specified by the manufacturer of the FID or HFID.

* * * * *

(c) *Initial and periodic calibration.* Prior to introduction into service, after any maintenance which could alter

calibration, and monthly thereafter, the FID or HFID hydrocarbon analyzer shall be calibrated on all normally used instrument ranges using the steps in this paragraph (c). Use the same flow rate and pressures as when analyzing samples. Calibration gases shall be introduced directly at the analyzer, unless the ''overflow'' calibration option of 40 CFR part 86, subpart N, for the HFID is taken. New calibration curves need not be generated each month if the existing curve can be verified as continuing to meet the requirements of paragraph (c)(3) of this section.

(1) Adjust analyzer to optimize performance.

(2) Zero the hydrocarbon analyzer with zero-grade air.

(3) Calibrate on each used operating range with propane-in-air (dilute or raw) or propane-in-nitrogen (raw) calibration gases having nominal concentrations starting between 10–15 percent and increasing in at least six incremental steps to 90 percent (e.g., 15, 30, 45, 60, 75, and 90 percent of that range) of that range. The incremental steps are to be spaced to represent good engineering practice. For each range calibrated, if the deviation from a least-squares best-fit straight line is 2 percent or less of the value at each data point, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds 2 percent at each non-zero data point and within ±0.3 percent of full scale on the zero, the best-fit non-linear equation which represents the data to within these limits shall be used to determine concentration.

(d) *Oxygen interference optimization (required for raw).* Choose a range where the oxygen interference check gases will fall in the upper 50 percent. Conduct the test, as outlined in this paragraph, with the oven temperature set as required by the instrument manufacturer. Oxygen interference check gas specifications are found in § 89.312(d).

* * * * *

(2) Span the analyzer with the 21% oxygen interference gas specified in § 89.312(d).

* * * * *

(6) Calculate the percent of oxygen interference (designated as percent O_2I) for each mixture in paragraph (d)(4) of this section.

percent $O_2I = ((B-C) \times 100)/B$

Where:

A = hydrocarbon concentration (ppmC) of the span gas used in paragraph (d)(2) of this section.

B = hydrocarbon concentration (ppmC) of the oxygen interference check gases used in paragraph (d)(4) of this section.

C = analyzer response (ppmC) = A/D; where

D = (percent of full-scale analyzer response due to A) × (percent of full-scale analyzer response due to B).

* * * * *

53. The newly designated § 89.320 is amended by revising paragraph (c) to read as follows:

§ 89.320 Carbon monoxide analyzer calibration.

* * * * *

(c) *Initial and periodic calibration.* Prior to its introduction into service, after any maintenance which could alter calibration, and every two months thereafter, the NDIR carbon monoxide analyzer shall be calibrated. New calibration curves need not be generated every two months if the existing curve can be verified as continuing to meet the requirements of paragraph (c)(3) of this section.

(1) Adjust the analyzer to optimize performance.

(2) Zero the carbon monoxide analyzer with either zero-grade air or zero-grade nitrogen.

(3) Calibrate on each used operating range with carbon monoxide-in-N_2 calibration gases having nominal concentrations starting between 10 and 15 percent and increasing in at least six incremental steps to 90 percent (e.g., 15, 30, 45, 60, 75, and 90 percent) of that range. The incremental steps are to be spaced to represent good engineering practice. For each range calibrated, if the deviation from a least-squares best-fit straight line is 2 percent or less of the value at each non-zero data point and within ± 0.3 percent of full scale on the zero, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds these limits, the best-fit non-linear equation which represents the data to within these limits shall be used to determine concentration.

* * * * *

54. The newly designated § 89.321 is amended by revising paragraph (c) to read as follows:

§ 89.321 Oxides of nitrogen analyzer calibration.

* * * * *

(c) *Initial and periodic calibration.* Prior to its introduction into service, after any maintenance which could alter calibration, and monthly thereafter, the chemiluminescent oxides of nitrogen analyzer shall be calibrated on all normally used instrument ranges. New calibration curves need not be generated each month if the existing curve can be verified as continuing to meet the requirements of paragraph (c)(3) of this section. Use the same flow rate as when analyzing samples. Proceed as follows:

(1) Adjust analyzer to optimize performance.

(2) Zero the oxides of nitrogen analyzer with zero-grade air or zero-grade nitrogen.

(3) Calibrate on each normally used operating range with NO-in-N_2 calibration gases with nominal concentrations starting at between 10 and 15 percent and increasing in at least six incremental steps to 90 percent (e.g., 15, 30, 45, 60, 75, and 90 percent) of that range. The incremental steps are to be spaced to represent good engineering practice. For each range calibrated, if the deviation from a least-squares best-fit straight line is 2 percent or less of the value at each non-zero data point and within ± 0.3 percent of full scale on the zero, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds these limits, the best-fit non-linear equation which represents the data to within these limits shall be used to determine concentration.

* * * * *

55. The newly designated § 89.322 is amended by revising paragraph (a) to read as follows:

§ 89.322 Carbon dioxide analyzer calibration.

(a) Prior to its introduction into service, after any maintenance which could alter calibration, and bi-monthly thereafter, the NDIR carbon dioxide analyzer shall be calibrated on all normally used instrument ranges. New calibration curves need not be generated each month if the existing curve can be verified as continuing to meet the requirements of paragraph (a)(3) of this section. Proceed as follows:

(1) Follow good engineering practices for instrument start-up and operation. Adjust the analyzer to optimize performance.

(2) Zero the carbon dioxide analyzer with either zero-grade air or zero-grade nitrogen.

(3) Calibrate on each normally used operating range with carbon dioxide-in-N_2 calibration or span gases having nominal concentrations starting between 10 and 15 percent and increasing in at least six incremental steps to 90 percent (e.g., 15, 30, 45, 60, 75, and 90 percent) of that range. The incremental steps are to be spaced to represent good engineering practice. For each range calibrated, if the deviation from a least-squares best-fit straight line is 2 percent or less of the value at each

non-zero data point and within ±0.3 percent of full scale on the zero, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds these limits, the best-fit non-linear equation which represents the data to within these limits shall be used to determine concentration.

* * * * *

56. The newly designated § 89.324 is revised to read as follows:

§ 89.324 Calibration of other equipment.

(a) Other test equipment used for testing shall be calibrated as often as required by the instrument manufacturer or necessary according to good practice.

(b) If a methane analyzer is used, the methane analyzer shall be calibrated prior to introduction into service and monthly thereafter:

(1) Follow the manufacturer's instructions for instrument startup and operation. Adjust the analyzer to optimize performance.

(2) Zero the methane analyzer with zero-grade air.

(3) Calibrate on each normally used operating range with CH_4 in air with nominal concentrations starting between 10 and 15 percent and increasing in at least six incremental steps to 90 percent (e.g., 15, 30, 45, 60, 75, and 90 percent) of that range. The incremental steps are to be spaced to represent good engineering practice. For each range calibrated, if the deviation from a least-squares best-fit straight line is 2 percent or less of the value at each non-zero data point and within ±0.3 percent of full scale on the zero, concentration values may be calculated by use of a single calibration factor for that range. If the deviation exceeds these limits, the best-fit non-linear equation which represents the data to within these limits shall be used to determine concentration.

57. The newly designated § 89.328 is amended by revising paragraphs (b)(1) and (b)(2) to read as follows:

§ 89.328 Inlet and exhaust restrictions.

* * * * *

(b) * * *

(1) Equip the test engine with an air inlet system presenting an air inlet restriction within 5 percent of the upper limit at maximum air flow, as specified by the engine manufacturer for a clean air cleaner. A system representative of the installed engine may be used. In other cases a test shop system may be used.

(2) The exhaust backpressure must be within 5 percent of the upper limit at maximum declared power, as specified by the engine manufacturer. A system representative of the installed engine may be used. In other cases a test shop system may be used.

58. The newly designated § 89.330 is amended by revising paragraph (b)(2) and adding paragraph (b)(3) to read as follows:

§ 89.330 Lubricating oil and test fuels.

* * * * *

(b) *Test fuels.* * * *

(2) Use petroleum fuel meeting the specifications in Table 4 in Appendix A of this subpart, or substantially equivalent specifications approved by the Administrator, for exhaust emission testing. The grade of diesel fuel used must be commercially designated as ''Type 2–D'' grade diesel fuel and recommended by the engine manufacturer.

(3) Testing of Tier 1 engines rated under 37 kW or Tier 2 engines rated at or above 37 kW that is conducted by the Administrator shall be performed using test fuels that meet the specifications in Table 4 in Appendix A of this subpart and that have a sulfur content no higher than 0.20 weight percent.

* * * * *

59–63. Tables 1 through 4 of Appendix A to subpart D are revised and Table 5 is removed to read as follows:

Appendix A To Subpart D—Tables

TABLE 1.—ABBREVIATIONS USED IN SUBPART D

CLD	Chemiluminescent detector.
CO	Carbon monoxide.
CO_2	Carbon dioxide.
HC	Hydrocarbons.
HCLD	Heated chemiluminescent detector.
HFID	Heated flame ionization detector.
GC	Gas chromatograph.
NDIR	Non-dispersive infra-red analyzer.
NIST	National Institute for Standards and Testing.
NO	Nitric Oxide.
NO_2	Nitrogen Dioxide.
NO_X	Oxides of nitrogen.
O_2	Oxygen.

TABLE 2.—SYMBOLS USED IN SUBPARTS D AND E

Symbol	Term	Unit
conc	Concentration (ppm by volume)	ppm
f	Engine specific parameter considering atmospheric conditions	
F_{FCB}	Fuel specific factor for the carbon balance calculation	
F_{FD}	Fuel specific factor for exhaust flow calculation on dry basis	
F_{FH}	Fuel specific factor representing the hydrogen to carbon ratio	
F_{FW}	Fuel specific factor for exhaust flow calculation on wet basis	
FR	Rate of fuel consumed	g/h
G_{AIRW}	Intake air mass flow rate on wet basis	kg/h
G_{AIRD}	Intake air mass flow rate on dry basis	kg/h
G_{EXHW}	Exhaust gas mass flow rate on wet basis	kg/h
G_{Fuel}	Fuel mass flow rate	kg/h
H	Absolute humidity (water content related to dry air)	g/kg
i	Subscript denoting an individual mode	
K_H	Humidity correction factor	
L	Percent torque related to maximum torque for the test mode	%
mass	Pollutant mass flow	g/h
$n_{d,i}$	Engine speed (average at the i'th mode during the cycle)	1/min
P_s	Dry atmospheric pressure	kPa
P_d	Test ambient saturation vapor pressure at ambient temperature	kPa
P	Observed brake power output uncorrected	kW
P_{AUX}	Declared total power absorbed by auxiliaries fitted for the test	kW
P_M	Maximum power measured at the test speed under test conditions	kW
P_i	$P_i = P_{M,i} + P_{AUX,i}$	
P_B	Total barometric pressure (average of the pre-test and post-test values)	kPa
P_v	Saturation pressure at dew point temperature	kPa

TABLE 2.—SYMBOLS USED IN SUBPARTS D AND E—Continued

Symbol	Term	Unit
R_a	Relative humidity of the ambient air	%
S	Dynamometer setting	kW
T	Absolute temperature at air inlet	K
T_{be}	Air temperature after the charge air cooler (if applicable) (average)	K
T_{clout}	Coolant temperature outlet (average)	K
T_{Dd}	Absolute dewpoint temperature	K
$T_{d,i}$	Torque (average at the i'th mode during the cycle)	N-m
T_{SC}	Temperature of the intercooled air	K
$T_{ref.}$	Reference temperature	K
V_{EXHD}	Exhaust gas volume flow rate on dry basis	m^3/h
V_{AIRW}	Intake air volume flow rate on wet basis	m^3/h
P_B	Total barometric pressure	kPa
V_{EXHW}	Exhaust gas volume flow rate on wet basis	m^3/h
WF	Weighing factor	
WF_E	Effective weighing factor	

TABLE 3.—MEASUREMENT ACCURACY AND CALIBRATION FREQUENCY

No.	Item	Calibration accuracy [1]	Calibration frequency
1	Engine speed	± 2%	30 days.
2	Torque	Larger of ± 2% of point or ± 1% of engine maximum.	30 days.
3	Fuel consumption (raw measurement)	± 2% of engine maximum	30 days.
4	Air consumption (raw measurement)	± 2% of engine maximum	As required.
5	Coolant temperature	±2°K	As required.
6	Lubricant temperature	±2°K	As required.
7	Exhaust backpressure	± 1.0% of engine maximum	As required.
8	Inlet depression	1.0% of engine maximum	As required.
9	Exhaust gas temperature	±15°K	As required.
10	Air inlet temperature (combustion air)	±2°K	As required.
11	Atmospheric pressure	± 0.5%	As required.
12	Humidity (combustion air) (g of H_2O/Kg of dry air).	± 0.5	As required.
13	Fuel temperature	±2°K	As required.
14	Temperature with regard to dilution tunnel	±2°K	As required.
15	Dilution air humidity (g of H_2O/Kg of dry air)	± 0.5	As required.
16	HC analyzer	± 2%	Monthly or as required.
17	CO analyzer	± 2%	Once per 60 days or as required.
18	NO_X analyzer	± 2%	Monthly or as required.
19	Methane analyzer	± 2%	Monthly or as required.
20	NO_X converter efficiency check	90%	Monthly.
21	CO_2 analyzer	± 2%	Once per 60 days or as required.

[1] All accuracy requirements pertain to the final recorded value which is inclusive of the data acquisition system.

TABLE 4.—FEDERAL TEST FUEL SPECIFICATIONS

Item	Procedure (ASTM) [1]	Value (type 2–D)
Cetane	D613–95	40–48
Distillation Range:		
IBP, °C	D86–97	171–204
10% point, °C	86–97	204–238
50% point, °C	86–97	243–282
90% point, °C	86–97	293–332
EP, °C	86–97	321–366
Gravity, API	D287–92	32–37
Total Sulfur, %mass	D129–95 or D2622–98	0.03—0.40
Hydrocarbon composition:		
Aromatics, %vol	D1319–98 or D5186–96	[2] 10
Paraffins, Naphthenes, Olefins	D1319–98	([3])
Flashpoint, °C (minimum)	D93–97	54
Viscosity @ 38°C, Centistokes	D445–97	2.0–3.2

[1] All ASTM procedures in this table have been incorporated by reference. See § 89.6.
[2] Minimum.
[3] Remainder.

Subpart E—[Amended]

64. The newly designated § 89.401 is amended by revising paragraph (b) to read as follows:

§ 89.401 Scope; applicability.

* * * * *

(b) Exhaust gases, either raw or dilute, are sampled while the test engine is operated using the appropriate test cycle on an engine dynamometer. The exhaust gases receive specific component analysis determining concentration of pollutant, exhaust volume, the fuel flow (raw analysis), and the power output during each mode. Emissions are reported as grams per kilowatt hour (g/kW-hr).

* * * * *

65. The newly designated § 89.402 is revised to read as follows:

§ 89.402 Definitions.

The definitions in subpart A of this part apply to this subpart. For terms not defined in this part, the definitions in 40 CFR part 86, subparts A, D, I, and N, apply to this subpart.

66. The newly designated § 89.404 is amended by revising paragraph (b) and removing paragraph (e) to read as follows:

§ 89.404 Test procedure overview.

* * * * *

(b) The test is designed to determine the brake-specific emissions of hydrocarbons, carbon monoxide, oxides of nitrogen, and particulate matter. For more information on particulate matter sampling see § 89.112(c). The test cycles consist of various steady-state operating modes that include different combinations of engine speeds and loads. These procedures require the determination of the concentration of each pollutant, exhaust volume, the fuel flow (raw analysis), and the power output during each mode. The measured values are weighted and used to calculate the grams of each pollutant emitted per kilowatt hour (g/kW-hr).

* * * * *

67. The newly designated § 89.405 is amended by revising paragraphs (d), (e), and (f) to read as follows:

§ 89.405 Recorded information.

* * * * *

(d) *Test data; pre-test.*

(1) Date and time of day.

(2) Test number.

(3) Intermediate speed and rated speed as defined in § 89.2 and maximum observed torque for these speeds.

(4) Recorder chart or equivalent. Identify the zero traces for each range used, and span traces for each range used.

(5) Air temperature after and pressure drop across the charge air cooler (if applicable) at maximum observed torque and rated speed.

(e) *Test data; modal.*

(1) Recorder chart or equivalent. Identify for each test mode the emission concentration traces and the associated analyzer range(s). Identify the start and finish of each test.

(2) Observed engine torque.

(3) Observed engine rpm.

(4) Record engine torque and engine rpm continuously during each mode with a chart recorder or equivalent recording device.

(5) Intake air flow (for raw mass flow sampling method only) and depression for each mode.

(6) Engine intake air temperature at the engine intake or turbocharger inlet for each mode.

(7) Mass fuel flow (for raw sampling) for each mode.

(8) Engine intake humidity.

(9) Coolant temperature outlet.

(10) Engine fuel inlet temperature at the pump inlet.

(f) *Test data; post-test.*

(1) Recorder chart or equivalent. Identify the zero traces for each range used and the span traces for each range used. Identify hangup check, if performed.

(2) Total number of hours of operation accumulated on the engine.

68. The newly designated § 89.406 is amended by revising paragraphs (b) and (c)(1) to read as follows:

§ 89.406 Pre-test procedures.

* * * * *

(b) Replace or clean the filter elements and then vacuum leak check the system per § 89.316(a). Allow the heated sample line, filters, and pumps to reach operating temperature.

(c) * * *

(1) Check the sample-line temperatures (see § 89.309(a)(4)(ii) and (a)(5)(i)(A)).

* * * * *

69. The newly designated § 89.407 is amended by revising paragraphs (a), (c), and (d)(2) to read as follows:

§ 89.407 Engine dynamometer test run.

(a) Measure and record the temperature of the air supplied to the engine, the fuel temperature, the intake air humidity, and the observed barometric pressure during the sampling for each mode. The fuel temperature shall be less than or equal to 43C during the sampling for each mode.

* * * * *

(c) The following steps are taken for each test:

(1) Install instrumentation and sample probes as required.

(2) Perform the pre-test procedure as specified in § 89.406.

(3) Read and record the general test data as specified in § 89.405(c).

(4) Start cooling system.

(5) Precondition (warm up) the engine in the following manner:

(i) For variable-speed engines:

(A) Operate the engine at idle for 2 to 3 minutes;

(B) Operate the engine at approximately 50 percent power at the peak torque speed for 5 to 7 minutes;

(C) Operate the engine at rated speed and maximum horsepower for 25 to 30 minutes;

(ii) For constant-speed engines:

(A) Operate the engine at minimum load for 2 to 3 minutes;

(B) Operate the engine at 50 percent load for 5 to 7 minutes;

(C) Operate the engine at maximum load for 25 to 30 minutes;

(iii) Optional. It is permitted to precondition the engine at rated speed and maximum horsepower until the oil and water temperatures are stabilized. The temperatures are defined as stabilized if they are maintained within 2 percent of point on an absolute basis for 2 minutes. The engine must be operated a minimum of 10 minutes for this option. This optional procedure may be substituted for the procedure in paragraph (c)(5)(i)or (c)(5)(ii) of this section;

(iv) Optional. If the engine has been operating on service accumulation for a minimum of 40 minutes, the service accumulation may be substituted for the procedure in paragraphs (c)(5)(i) through (iii) of this section.

(6) Read and record all pre-test data specified in § 89.405(d).

(7) Start the test cycle (see § 89.410) within 20 minutes of the end of the warmup. (See paragraph (c)(13) of this section.) A mode begins when the speed and load requirements are stabilized to within the requirements of § 89.410(b). A mode ends when valid emission sampling for that mode ends. For a mode to be valid, the speed and load requirements must be maintained continuously during the mode. Sampling in the mode may be repeated until a valid sample is obtained as long the speed and torque requirements are met.

(8) Calculate the torque for any mode with operation at rated speed.

(9) During the first mode with intermediate speed operation, if applicable, calculate the torque corresponding to 75 and 50 percent of the maximum observed torque for the intermediate speed.

(10) Record all modal data specified in § 89.405(e) during a minimum of the last 60 seconds of each mode.

(11) Record the analyzer(s) response to the exhaust gas during the a minimum of the last 60 seconds of each mode.

(12) Test modes may be repeated, as long as the engine is preconditioned by running the previous mode. In the case of the first mode of any cycle, precondition according to paragraph (c)(5) of this section.

(13) If a delay of more than 20 minutes, but less than 4 hours, occurs between the end of one mode and the beginning of another mode, precondition the engine by running the previous mode. If the delay exceeds 4 hours, the test shall include preconditioning (begin at paragraph (c)(2) of this section).

(14) The speed and load points for each mode are listed in Tables 1 through 4 of Appendix B of this subpart. The engine speed and load shall be maintained as specified in § 89.410(b).

(15) If at any time during a test mode, the test equipment malfunctions or the specifications in paragraph (c)(14) of this section are not met, the test mode is void and may be aborted. The test mode may be restarted by preconditioning with the previous mode.

(16) Fuel flow and air flow during the idle load condition may be determined just prior to or immediately following the dynamometer sequence, if longer times are required for accurate measurements.

(d) * * *

(2) Each analyzer range that may be used during a test mode must have the zero and span responses recorded prior to the execution of the test. Only the zero and span for the range(s) used to measure the emissions during the test are required to be recorded after the completion of the test .

* * * * *

70. The newly designated § 89.408 is amended by revising paragraph (e) to read as follows:

§ 89.408 Post-test procedures.

* * * * *

(e) For a valid test, the zero and span checks performed before and after each test for each analyzer must meet the following requirements:

(1) The span drift (defined as the change in the difference between the zero response and the span response) must not exceed 3 percent of full-scale chart deflection for each range used.

(2) The zero response drift must not exceed 3 percent of full-scale chart deflection.

71. The newly designated § 89.410 is amended by revising paragraphs (a), (b), and (c) to read as follows:

§ 89.410 Engine test cycle.

(a) Emissions shall be measured using one of the test cycles specified in Tables 1 through 4 of Appendix B of this subpart, subject to the provisions of paragraphs (a)(1) through (a)(4) of this section. These cycles shall be used to test engines on a dynamometer.

(1) The 8-mode test cycle described in Table 1 of Appendix B of this subpart shall be used for all engines, except constant speed engines, engines rated under 19 kW, and propulsion marine diesel engines.

(2) The 5-mode test cycle described in Table 2 of Appendix B of this subpart shall be used for constant-speed engines as defined in § 89.2. Any engine certified under this test cycle must meet the labeling requirements of § 89.110(b)(11).

(3) The 6-mode test cycle described in Table 3 of Appendix B of this subpart shall be used for variable speed engines rated under 19 kW.

(4) Notwithstanding the provisions of paragraphs (a)(1) through (a)(3) of this section, the 4-mode test cycle described in Table 4 of Appendix B of this subpart shall be used for propulsion marine diesel engines.

(5) Notwithstanding the provisions of paragraphs (a)(1) through (a)(4) of this section:

(i) Manufacturers may use the 8-mode test cycle described in Table 1 of Appendix B of this subpart for:

(A) Constant speed engines, or variable speed engines rated under 19 kW; or

(B) Propulsion marine diesel engines, provided the propulsion marine diesel engines are certified in an engine family that includes primarily non-marine diesel engines, and the manufacturer obtains advance approval from the Administrator.

(ii) The Administrator may use the 8-mode test cycle specified in Table 1 of Appendix B of this subpart during testing of any engine which was certified based on emission data collected from that test cycle.

(b) During each non-idle mode, hold the specified load to within 2 percent of the engine maximum value and speed to within ±2 percent of point. During each idle mode, speed must be held within the manufacturer’s specifications for the engine, and the throttle must be in the fully closed position and torque must not exceed 5 percent of the peak torque value of mode 5.

(c) For any mode except those involving either idle or full-load operation, if the operating conditions specified in paragraph (b) of this section cannot be maintained, the Administrator may authorize deviations from the specified load conditions. Such deviations shall not exceed 10 percent of the maximum torque at the test speed. The minimum deviations above and below the specified load necessary for stable operation shall be determined by the manufacturer and approved by the Administrator prior to the test run.

* * * * *

72. The newly designated § 89.411 is amended by revising paragraphs (d)(5) and (e)(5) to read as follows:

§ 89.411 Exhaust sample procedure—gaseous components.

* * * *

(d) * * *

(5) Zero and span each range to be used on each analyzer operated prior to the beginning of the test cycle. The span gases shall have a concentration between 75 and 100 percent of full-scale chart deflection. The flow rates and system pressures shall be approximately the same as those encountered during sampling. The HFID analyzer shall be zeroed and spanned either through the overflow sampling system or through the analyzer port.

* * * * *

(e) * * *

(5) If the difference between the readings obtained greater than or equal to 2 percent of full scale deflection, clean the sample probe and the sample line.

* * * * *

73. The newly designated § 89.412 is amended by revising paragraph (c)(3) and removing and reserving paragraph (g)(1) to read as follows:

§ 89.412 Raw gaseous exhaust sampling and analytical system description.

* * * * *

(c) * * *

(3) The location of optional valve V16 may not be greater than 61 cm from the sample pump.

* * * * *

(g) * * *

(1) [Reserved].

* * * * *

74. The newly designated § 89.413 is amended by revising paragraph (d) and removing paragraph (e) to read as follows:

§ 89.413 Raw sampling procedures.

* * * * *

(d) All gaseous heated sampling lines shall be fitted with a heated filter to extract solid particles from the flow of gas required for analysis. The sample

line for CO and CO_2 analysis may be heated or unheated.

75. The newly designated § 89.414 is amended by revising paragraph (a) to read as follows:

§ 89.414 Air flow measurement specifications.

(a) The air flow measurement method used must have a range large enough to accurately measure the air flow over the engine operating range during the test. Overall measurement accuracy must be ±2 percent of the maximum engine value for all modes. The Administrator must be advised of the method used prior to testing.

* * * * *

76. The newly designated § 89.415 is revised to read as follows:

§ 89.415 Fuel flow measurement specifications.

The fuel flow rate measurement instrument must have a minimum accuracy of 2 percent of the engine maximum fuel flow rate. The controlling parameters are the elapsed time measurement of the event and the weight or volume measurement.

77. The newly designated § 89.418 is amended by revising paragraphs (b), (c), (d), (f) introductory text, (f)(1), and (g) and the table in paragraph (e) to read as follows:

§ 89.418 Raw emission sampling calculations.

* * * * *

(b) The exhaust gas flow rate G_{EXHW} and V_{EXHW} shall be determined for each mode.

(1) For measurements using the mass flow method, see § 89.416(a).

(2) For measurements using the fuel consumption and exhaust gas concentrations method, use the following equations:

$$G_{EXHW} = G_{fuel} + G_{aird}\left(1+\left(\frac{H}{1000}\right)\right)$$

Where:

$$G_{aird} = \frac{G_{fuel}}{(fla)} = \frac{\text{Mass Fuel Measured}}{G_{airw}\times\left(1-\frac{H}{1000}\right)}$$

$$(fla) = \frac{4.77\,(1+\alpha/4)\,(fla)_{stoich}}{\frac{1}{X}-\left(\frac{DCO}{2\,X\,(10)^6}\right)-\left(\frac{DHC}{X\,(10)^6}\right)+\frac{\alpha}{4}\left(1-\frac{DHC}{X\,(10)^6}\right)-\frac{0.75\,\alpha}{\left(\frac{K}{\left(\frac{DCO}{X\,(10)^6}\right)}\right)+\left(\frac{(1-K)}{\left(1-\frac{DHC}{X\,(10)^6}\right)}\right)}}$$

$$(fla)_{Stoich} = \frac{M_c + \alpha M_H}{138.18\,(1+\alpha/4)}$$

$$X = \frac{DCO_2}{10^2} + \frac{DCO}{10^6} + \frac{DHC}{10^6}$$

K = 3.5

(3) Humidity values may be calculated from either one of the following equations:

$$H = \frac{6.22\times R_a \times p_d}{p_R - \left(p_d \times R_a \times 10^{-2}\right)}$$

or

$$H = \frac{622\times P_v}{\left(P_B - P_v\right)}$$

(c) When applying $G_{EXHW,}$ the measured ‘‘dry’’ concentration shall be corrected to a wet basis, if not already measured on a wet basis. This section is applicable only for measurements made on raw exhaust gas. Correction to a wet basis shall be according to the following formula:

$Conc_{WET} = K_w \times Conc_{DRY}$

Where: K_W is determined according to the equations in paragraph (c)(1) or (c)(2) of this section.

(1) For measurements using the mass flow method (see § 89.416(a)):

$$K_W = \left[1 - F_{FH}\times\frac{G_{fuel}}{G_{aird}}\right] - K_{W1}$$

Where:

$$F_{FH} = ALF \times 0.1448 \times \frac{1}{1+\left(\frac{G_{fuel}}{G_{aird}}\right)} \text{ for diesel fuel only}$$

$$ALF = \text{Hydrogen mass percentage of fuel} = \frac{1.008\times\alpha}{12.01+1.008\times\alpha}\times 100 = 13.12 \text{ for } CH_{1.8}\text{fuel}$$

α = H/C mole ratio of the fuel.

(2) For measurements using the fuel consumption and exhaust gas concentrations method (see § 89.416(b)):

$$K_W = \frac{1}{1+1.8\times 0.005\times\left[\frac{DCO}{10^4} = DCO_2\right]} - K_{W1}$$

Where:

$$K_{W1} = \frac{1.608 \times H}{1000 + 1.608 \times H}$$

(d) As the NO_X emission depends on intake air conditions, the NO_X concentration shall be corrected for intake air temperature and humidity with the factor K_h given in the following formula. For engines operating on alternative combustion cycles, other correction formulas may be used if they can be justified or validated. The formula follows:

$$K_H = \frac{1}{1 - 0.0182\,(H - 10.71)}$$

(e) * * *

Gas	u	v	w	conc.
NO_X	0.001587	0.00205	0.00205	ppm.
CO	0.000966	0.00125	0.00125	ppm.
HC	0.000478		0.000618	ppm.
CO_2	15.19	19.64	19.64	percent.

NOTE: The given coefficients u, v, and w are calculated for 273.15 °K (0 °C) and 101.3 kPa. In cases where the reference conditions vary from those stated, an error may occur in the calculations.

(f) The following equations may be used to calculate the coefficients u, v, and w in paragraph (e) of this section for other conditions of temperature and pressure:

(1) For the calculation of u, v, and w for NO_X (as NO_2), CO, HC (in paragraph (e) of this section as $CH_{1.80}$), CO_2, and O2:

Where:

$w = 4.4615.10^{-5} \times M$ if conc. in ppm

$w = 4.4615.10^{-1} \times M$ if conc. in percent

v = w

$u = w/\rho_{Air}$

M = Molecular weight

ρ_{Air} = Density of dry air at 273.15 °K (0 °C), 101.3 kPa = 1.293 kg/m^3

* * * * *

(g)(1) The emission shall be calculated for all individual components in the following way where power at idle is equal to zero:

$$\text{individualgas} = \frac{\sum_{i=1}^{i=n}(g_i \times WF_i)}{\sum_{i=1}^{i=n}(P_i \times WF_i)}$$

(2) The weighting factors and the number of modes (n) used in the calculation in paragraph (g)(1) of this section are according to § 89.410.

78. The newly designated § 89.420 is amended by revising paragraph (a) introductory text to read as follows:

§ 89.420 Background sample.

(a) Background samples are produced by continuously drawing a sample of dilution air during the exhaust collection phase of each test cycle mode.

* * * * *

79. The newly designated § 89.422 is amended by revising the table in paragraph (d)(3) to read as follows:

§ 89.422 Dilute sampling procedures—CVS calibration.

* * * * *

(d) * * *

(3) * *

CALIBRATION DATA MEASUREMENTS

Parameter	Symbol	Units	Tolerances
Barometric pressure (corrected)	P_B	kPa (Inches Hg)	0.034 (0.01).
Air temperature, flowmeter	ETI	deg.C (deg.F)	0.14 (0.25).
Pressure depression upstream of LFE	EPI	kPa(Inches H_2O)	0.012 (0.05).
Pressure drop across LFE matrix	EDP	kPa (Inches H_2O)	0.001 (0.005).
Air flow	Q_s	m^3/min. (Ft^3/min)	0.5 pct.
CFV inlet depression	PPI	kPa (Inches Hg)	0.055 (0.016).
CFV outlet pressure	PPO	kPa (Inches Hg)	0.17 (0.05).
Temperature at venturi inlet	T_v	deg.C (deg.F)	0.28 (0.5)
Specific gravity of manometer fluid	Sp.Gr		(1.75 oil).

* * * *

§ 89.423 [Removed and Reserved]

80. Remove and reserve the newly designated § 89.423.

81. The newly designated § 89.424 is amended by revising paragraphs (a), (d)(6), and (e), and the definition for M^1 in the CO_{2e} equation in paragraph (d)(3) to read as follows:

§ 89.424 Dilute emission sampling calculations.

(a) The final reported emission test results are computed by use of the following formula:

$$A_{WM} = \frac{\sum_{i=1}^{i=n}(g_i \times WF_i)}{\sum_{i=1}^{i=n}(P_i \times WF_i)}$$

Where:

A_{wm} = Weighted mass emission level (HC, CO, CO_2, PM, or NO_X) in g/kW-hr.

g_i = Mass flow in grams per hour, = grams measured during the mode divided by the sample time for the mode.

WF_i = Effective weighing factor.

P_i = Power measured during each mode (Power set = zero for the idle mode).

* * * * *

(d) * * *

(3) * * *

M^1 = Fuel mass consumed during the mode.

* * * * *

(6) Measured ‘‘dry’’ concentrations shall be corrected to a wet basis, if not already measured on a wet basis. This section is applicable only for measurements made on dilute exhaust gas. Correction to a wet basis shall be according to the following formula:

$$Conc_{WET} = K_W \times Conc_{DRY}$$

Where: K_W is determined according to the equation in paragraph (d)(6)(i) or (d)(6)(ii), of this section.

(i) For wet CO_2 measurement:

$$K_w = \left(1 - \frac{\alpha \times CO_2\%conc(wet)}{200}\right) - K_{w1}$$

(ii) For dry CO_2 measurement:

$$K_w = \left(\frac{(1 - K_{W1})}{1 + \frac{\alpha \times CO_2\%conc(dry)}{200}}\right)$$

(iii) For the equations in paragraph (d)(6)(i) and (d)(6)(ii) of this section, the following equation applies:

$$K_{w1} = \frac{1.608 \times \left[H_d \times \left(1 - {}^1\!/_{DF}\right) + H_a \times \left({}^1\!/_{DF}\right)\right]}{1000 + \left\{1.608 \times \left[H_d \times \left(1 - {}^1\!/_{DF}\right) + H_a \times \left({}^1\!/_{DF}\right)\right]\right\}} +$$

Where: H_a and H_d are the grams of water per kilogram of dry air; as illustrated in the following equations:

$$H_d = \frac{6.22 \times R_d \times p_d}{p_B - \left(p_d \times R_d \times 10^{-2}\right)}$$

$$H_a = \frac{6.22 \times R_a \times p_a}{p_B - \left(p_a \times R_a \times 10^{-2}\right)}$$

(e) The final modal reported brake-specific fuel consumption (bsfc) shall be computed by use of the following formula:

$$bsfc = \frac{M}{kW - hr}$$

Where:

bsfc = brake-specific fuel consumption for a mode in grams of fuel per kilowatt-hour (kW-hr).

M = mass of fuel in grams, used by the engine during a mode.

kW-hr = total kilowatts integrated with respect to time for a mode.

* * * * *

§ 89.425 [Removed and Reserved]

82. Remove and reserve the newly designated § 89.425.

83–87. Appendix B to Subpart E of part 89 is revised to read as follows:

Appendix B To Subpart E of Part 89—Tables

TABLE 1.—8-MODE TEST CYCLE FOR VARIABLE-SPEED ENGINES

Test segment	Mode number	Engine speed [1]	Observed torque [2] (percent of max. observed)	Minimum time in mode (minutes)	Weighting factors
1	1	Rated	100	5.0	0.15
1	2	Rated	75	5.0	0.15
1	3	Rated	50	5.0	0.15
1	4	Rated	10	5.0	0.10
2	5	Int	100	5.0	0.10
2	6	Int	75	5.0	0.10
2	7	Int	50	5.0	0.10
2	8	Idle	0	5.0	0.15

[1] Engine speed (non-idle): ±2 percent of point. Engine speed (idle): Within manufacturer's specifications. Idle speed is specified by the manufacturer.

[2] Torque (non-idle): Throttle fully open for 100 percent points. Other non-idle points: ±2 percent of engine maximum value. Torque (idle): Throttle fully closed. Load less than 5 percent of peak torque.

TABLE 2.—5-MODE TEST CYCLE FOR CONSTANT-SPEED ENGINES

Mode number	Engine[1] Speed	Observed torque [2] (percent of max. observed)	Minimum time in mode (minutes)	Weighting factors
1	Rated	100	5.0	0.05
2	Rated	75	5.0	0.25
3	Rated	50	5.0	0.30
4	Rated	25	5.0	0.30
5	Rated	10	5.0	0.10

[1] Engine speed: ±2 percent of point.

[2] Torque: Throttle fully open for 100 percent point. Other points: ±2 percent of engine maximum value.

TABLE 3.—6-MODE TEST CYCLE FOR ENGINES RATED UNDER 19 KW

Mode number	Engine speed [1]	Observed torque [2] (percent of max. observed)	Minimum time in mode (minutes)	Weighting factors
1	Rated	100	5.0	0.09
2	Rated	75	5.0	0.20
3	Rated	50	5.0	0.29
4	Rated	25	5.0	0.30
5	Rated	10	5.0	0.07
6	Idle	0	5.0	0.05

[1] Engine speed (non-idle): ±2 percent of point. Engine speed (idle): Within manufacturer's specifications. Idle speed is specified by the manufacturer.
[2] Torque (non-idle): Throttle fully open for operation at 100 percent point. Other nonidle points: ±2 percent of engine maximum value. Torque (idle): Throttle fully closed. Load less than 5 percent of peak torque.

TABLE 4.—4-MODE TEST CYCLE FOR PROPULSION MARINE DIESEL ENGINES

Mode number	Engine speed [1] (percent of max. observed)	Observed power [2] (percent of max. observed)	Minimum time in mode (minutes)	Weighting factors
1	100	100	5.0	0.20
2	91	75	5.0	0.50
3	80	50	5.0	0.15
4	63	25	5.0	0.15

[1] Engine speed: ±2 percent of point.
[2] Power: Throttle fully open for operation at 100 percent point. Other points: ±2 percent of engine maximum value.

Subpart F—[Amended]

88. The newly designated § 89.505 is amended by revising paragraph (e) to read as follows:

§ 89.505 Maintenance of records; submittal of information.

* * * * *

(e) All reports, submissions, notifications, and requests for approvals made under this subpart are addressed to: Director, Engine Programs and Compliance Division (6405–J), U.S. Environmental Protection Agency, 401 M Street SW, Washington, DC 20460.

89. The newly designated § 89.506 is amended by revising paragraph (g) to read as follows:

§ 89.506 Right of entry and access.

* * * * *

(g) A manufacturer is responsible for locating its foreign testing and manufacturing facilities in jurisdictions where local law does not prohibit an EPA enforcement officer(s) or EPA authorized representative(s) from conducting the entry and access activities specified in this section. EPA will not attempt to make any inspections which it has been informed that local foreign law prohibits.

90. The newly designated § 89.509 is amended by revising paragraphs (a) and (b) to read as follows.

§ 89.509 Calculation and reporting of test results.

(a) Initial test results are calculated following the applicable test procedure specified in § 89.508(a). The manufacturer rounds these results, in accordance with ASTM E29–93a, to the number of decimal places contained in the applicable emission standard expressed to one additional significant figure. This procedure has been incorporated by reference. See § 89.6.

(b) Final test results are calculated by summing the initial test results derived in paragraph (a) of this section for each test engine, dividing by the number of tests conducted on the engine, and rounding in accordance with the procedure specified in paragraph (a) of this section to the same number of decimal places contained in the applicable standard expressed to one additional significant figure.

* * * * *

91. The newly designated § 89.512 is amended by revising paragraph (b) to read as follows.

§ 89.512 Request for public hearing.

* * * * *

(b) The manufacturer's request must be filed with the Administrator not later than 15 days after the Administrator's notification of the decision to suspend or revoke, unless otherwise specified by the Administrator. The manufacturer must simultaneously serve two copies of this request upon the Director of the Engine Programs and Compliance Division and file two copies with the Hearing Clerk of the Agency. Failure of the manufacturer to request a hearing within the time provided constitutes a waiver of the right to a hearing. Subsequent to the expiration of the period for requesting a hearing as of right, the Administrator may, at her or his discretion and for good cause shown, grant the manufacturer a hearing to contest the suspension or revocation.

* * * * *

92. The newly designated § 89.513 is amended by revising paragraph (e)(2) to read as follows.

§ 89.513 Administrative procedures for public hearing.

* * * * *

(e) Filing and service. * * *

(2) To the maximum extent possible, testimony will be presented in written form. Copies of written testimony will be served upon all parties as soon as practicable prior to the start of the hearing. A certificate of service will be provided on or accompany each document or paper filed with the Hearing Clerk. Documents to be served upon the Director of the Engine Programs and Compliance Division must be sent by registered mail to: Director, Engine Programs and Compliance Division (6405–J), U.S. Environmental Protection Agency, 401

M Street SW., Washington, DC 20460. Service by registered mail is complete upon mailing.

* * * * *

Subpart G—[Amended]

93. The newly designated § 89.602 is amended by revising the definition for ''Fifteen working day hold period'' to read as follows:

§ 89.602 Definitions.

* * * * *

Fifteen working day hold period. The period of time between a request for final admission and the automatic granting of final admission (unless EPA intervenes) for a nonconforming nonroad engine conditionally imported pursuant to § 89.605 or § 89.609. Day one of the hold period is the first working day (see definition for ''working day'' in this section) after the Engine Programs and Compliance Division of EPA receives a complete and valid application for final admission.

* * * * *

94. The newly designated § 89.603 is amended by revising paragraph (d) to read as follows:

§ 89.603 General requirements for importation of nonconforming nonroad engines.

* * * * *

(d) The ICI must submit to the Engine Programs and Compliance Division of EPA a copy of all approved applications for certification used to obtain certificates of conformity for the purpose of importing nonconforming nonroad engines pursuant to § 89.605 or § 89.609. In addition, the ICI must submit to the Engine Programs and Compliance Division a copy of all approved production changes implemented pursuant to § 89.605 or subpart B of this part. Documentation submitted pursuant to this paragraph (d) must be provided to the Engine Programs and Compliance Division within 10 working days of approval of the certification application (or production change) by EPA.

95. The newly designated § 89.604 is amended by revising paragraphs (c)(4) and (d) to read as follows:

§ 89.604 Conditional admission.

* * * * *

(c) * * *

(4) A copy of the written record is to be submitted to the Engine Programs and Compliance Division of EPA within five working days of the transfer date.

(d) Notwithstanding any other requirement of this subpart or U.S. Customs Service regulations, an ICI may also assume responsibility for the modification and testing of a nonconforming nonroad engine which was previously imported by another party. The ICI must be a holder of a currently valid certificate of conformity for that specific nonroad engine or authorized to import it pursuant to § 89.609 at the time of assuming such responsibility. The ICI must comply with all the requirements of § 89.603, § 89.604, and either § 89.605 or § 89.609, as applicable. For the purposes of this subpart, the ICI has ''imported'' the nonroad engine as of the date the ICI assumes responsibility for the modification and testing of the nonroad engine. The ICI must submit written notification to the Engine Programs and Compliance Division of EPA within 10 working days of the assumption of that responsibility.

96. The newly designated § 89.605 is amended by revising paragraphs (a)(2)(i), (a)(3)(vi), and (c) to read as follows:

§ 89.605 Final admission of certified nonroad engines.

(a) * * *

(2) * * *

(i) The ICI attests that the nonroad engine has been modified in accordance with the provisions of the ICI's certificate of conformity; presents to EPA a statement written by the applicable Original Engine Manufacturer that the Original Engine Manufacturer must provide to the ICI, and to EPA, information concerning production changes to the class of nonroad engines described in the ICI's application for certification; delivers to the Engine Programs and Compliance Division of EPA notification by the ICI of any production changes already implemented by the Original Engine Manufacturer at the time of application and their effect on emissions; and obtains from EPA written approval to use this demonstration option; or.

* * * * *

(3) * * *

(vi) A report concerning these production changes is to be made to the Engine Programs and Compliance Division of EPA within ten working days of initiation of the production change. The cause of any failure of an emission test is to be identified, if known;

* * * * *

(c) Except as provided in paragraph (b) of this section, EPA approval for final admission of a nonroad engine under this section is presumed to have been granted if the ICI does not receive oral or written notice from EPA to the contrary within 15 working days of the date that the Engine Programs and Compliance Division of EPA receives the ICI's application under paragraph (a) of this section. EPA notice of nonapproval may be made to any employee of the ICI. It is the responsibility of the ICI to ensure that the Engine Programs and Compliance Division of EPA receives the application and to confirm the date of receipt. During this 15 working day hold period, the nonroad engine is to be stored at a location where the Administrator has reasonable access to the nonroad engine for the Administrator's inspection. The storage is to be within 50 miles of the ICI's testing facility to allow the Administrator reasonable access for inspection and testing. A storage facility not meeting this criterion must be approved in writing by the Administrator prior to the submittal of the ICI's application under paragraph (a) of this section.

97. The newly designated § 89.609 is amended by revising paragraph (d) to read as follows:

§ 89.609 Final admission of modification nonroad engines and test nonroad engines.

* * * * *

(d) Except as provided in paragraph (c) of this section, EPA approval for final admission of a nonroad engine under this section is presumed to have been granted if the ICI does not receive oral or written notice from EPA to the contrary within 15 working days of the date that the Engine Programs and Compliance Division of EPA receives the ICI's application under paragraph (b) of this section. Such EPA notice of nonapproval may be made to any employee of the ICI. It is the responsibility of the ICI to ensure that the Engine Programs and Compliance Division of EPA receives the application and to confirm the date of receipt. During this 15 working day hold period, the nonroad engine is stored at a location where the Administrator has reasonable access to the nonroad engine for the Administrator's inspection. The storage is to be within 50 miles of the ICI's testing facility to allow the Administrator reasonable access for inspection and testing. A storage facility not meeting this criterion must be approved in writing by the Administrator prior to the submittal of the ICI's application under paragraph (b) of this section.

* * * * *

98. The newly designated § 89.610 is amended by revising paragraph (b)(1) to read as follows:

§ 89.610 Maintenance instructions, warranties, emission labeling.

* * * * *

(b) * * * (1) ICIs must submit to the Engine Programs and Compliance Division of EPA sample copies (including revisions) of any warranty documents required by this section prior to importing nonroad engines under this subpart.

* * * * *

99. The newly designated § 89.611 is amended by revising paragraph (g) to read as follows:

§ 89.611 Exemptions and exclusions.

* * * * *

(g) An application for exemption and exclusion provided for in paragraphs (b), (c), and (e) of this section is to be mailed to: U.S. Environmental Protection Agency, Office of Mobile Sources, Engine Programs and Compliance Division (6405–J), 401 M Street, SW, Washington, DC 20460, Attention: Imports.

Subpart J—[Amended]

100. Section 89.903 is amended by revising paragraph (b) to read as follows:

§ 89.903 Application of section 216(10) of the Act.

* * * * *

(b) EPA will maintain a list of nonroad engines that have been determined to be excluded because they are used solely for competition. This list will be available to the public and may be obtained by writing to the following address: Chief, Selective Enforcement Auditing Section, Engine Programs and Compliance Division (6405–J), Environmental Protection Agency, 401 M Street SW, Washington, DC 20460.

* * * * *

101. Section 89.905 is amended by revising paragraph (f) to read as follows:

§ 89.905 Testing exemption.

* * * * *

(f) A manufacturer of new nonroad engines may request a testing exemption to cover nonroad engines intended for use in test programs planned or anticipated over the course of a subsequent one-year period. Unless otherwise required by the Director, Engine Programs and Compliance Division, a manufacturer requesting such an exemption need only furnish the information required by paragraphs (a)(1) and (d)(2) of this section along with a description of the record-keeping and control procedures that will be employed to assure that the engines are used for purposes consistent with paragraph (a) of this section.

102. Section 89.906 is amended by revising paragraphs (a)(3) introductory text, (a)(3)(iii)(D), and (b) to read as follows:

§ 89.906 Manufacturer-owned exemption and precertification exemption.

(a) * * *

(3) Unless the requirement is waived or an alternate procedure is approved by the Director, Engine Programs and Compliance Division, the manufacturer must permanently affix a label to each nonroad engine on exempt status. This label should:

* * * * *

(iii) * * *

(D) The statement ‘‘This nonroad engine is exempt from the prohibitions of 40 CFR 89.1003.’’

* * * * *

(b) Any independent commercial importer that desires a precertification exemption pursuant to § 89.611(b)(3) and is in the business of importing, modifying, or testing uncertified nonroad engines for resale under the provisions of subpart G of this part, must apply to the Director, Engine Programs and Compliance Division. The Director may require such independent commercial importer to submit information regarding the general nature of the fleet activities, the number of nonroad engines involved, and a demonstration that adequate record-keeping procedures for control purposes will be employed.

103. Section 89.911 is revised to read as follows:

§ 89.911 Submission of exemption requests.

Requests for exemption or further information concerning exemptions and/or the exemption request review procedure should be addressed to: Chief, Selective Enforcement Auditing Section, Engine Programs and Compliance Division (6405–J), Environmental Protection Agency, 401 M Street SW, Washington, DC 20460.

104. Section 89.1003 is amended by revising paragraphs (a)(3), (a)(5), (a)(6), (b)(4), and (b)(7) to read as follows:

§ 89.1003 Prohibited acts.

(a) * * *

(3)(i) For a person to remove or render inoperative a device or element of design installed on or in a nonroad engine, vehicle or equipment in compliance with regulations under this part prior to its sale and delivery to the ultimate purchaser, or for a person knowingly to remove or render inoperative such a device or element of design after the sale and delivery to the ultimate purchaser; or

(ii) For a person to manufacture, sell or offer to sell, or install, a part or component intended for use with, or as part of, a nonroad engine, vehicle or equipment, where a principal effect of the part or component is to bypass, defeat, or render inoperative a device or element of design installed on or in a nonroad engine in compliance with regulations issued under this part, and where the person knows or should know that the part or component is being offered for sale or installed for this use or put to such use; or

(iii) for a person to deviate from the provisions of § 89.130 when rebuilding an engine (or rebuilding a portion of an engine or engine system).

* * * * *

(5) For a person to circumvent or attempt to circumvent the residence time requirements of paragraph (2)(iii) of the nonroad engine definition in § 89.2.

(6) For a manufacturer of nonroad vehicles or equipment to distribute in commerce, sell, offer for sale, or introduce into commerce a nonroad vehicle or piece of equipment which contains an engine not covered by a certificate of conformity, except as otherwise allowed by this part.

(b) * * *

(4) Certified nonroad engines shall be used in all vehicles and equipment manufactured on or after the applicable model years in § 89.112 that are self-propelled, portable, transportable, or are intended to be propelled while performing their function, unless the manufacturer of the vehicle or equipment can prove that the vehicle or equipment will be used in a manner consistent with paragraph (2) of the definition of nonroad engine in § 89.2. After the date on which a new standard takes effect, nonroad vehicle and equipment manufacturers may continue to use nonroad engines built prior to this date that are not certified to the standard until inventories of those engines are depleted; however, stockpiling of such nonroad engines will be considered a violation of this section.

* * * * *

(7) A new nonroad engine intended solely to replace a nonroad engine in a piece of nonroad equipment, where the engine requiring replacement is not certified or is certified to emission standards that are less stringent than those in effect when the replacement engine is built, shall not be subject to the prohibitions of paragraph (a)(1) of this section or to the requirements of § 89.105 and paragraph (b)(4) of this section, provided that:

(i) The engine manufacturer has ascertained that no engine produced by itself or by the manufacturer of the engine that is being replaced, if different, and certified to the

requirements of this subpart, is available with the appropriate physical or performance characteristics to repower the equipment; and

(ii) The engine manufacturer or its agent takes ownership and possession of the engine being replaced in partial exchange for the replacement engine; and

(iii) The replacement engine is clearly labeled with the following language, or similar alternate language approved by the Administrator: THIS ENGINE DOES NOT COMPLY WITH FEDERAL NONROAD OR ON-HIGHWAY EMISSION REQUIREMENTS. SALE OR INSTALLATION OF THIS ENGINE FOR ANY PURPOSE OTHER THAN AS A REPLACEMENT ENGINE FOR AN ENGINE MANUFACTURED PRIOR TO JANUARY 1 [INSERT APPROPRIATE YEAR] IS A VIOLATION OF FEDERAL LAW SUBJECT TO CIVIL PENALTY; and

(iv) In cases where an engine is to be imported for replacement purposes under the provisions of this paragraph (b)(7), the term ''engine manufacturer'' shall not apply to an individual or other entity that does not possess a current Certificate of Conformity issued by EPA under this part; and

(v) Where the replacement engine is intended to replace an engine that is certified to emission standards that are less stringent than those in effect when the replacement engine is built, the replacement engine shall be identical in all material respects to a certified configuration of the same or later model year as the engine being replaced; and

(vi) Engines sold pursuant to the provisions of this paragraph (b)(7) will neither generate nor use emission credits and will not be part of any accounting under the averaging, banking and trading program.

105. Section 89.1007 is amended by revising paragraph (c) to read as follows:

§ 89.1007 Warranty provisions.

* * * * *

(c) For the purposes of this section, the owner of any nonroad engine warranted under this part is responsible for the proper maintenance of the engine. Proper maintenance includes replacement and service, at the owner's expense at a service establishment or facility of the owner's choosing, of all parts, items, or devices related to emission control (but not designed for emission control) under the terms of the last sentence of section 207(a)(3) of the Act, unless such part, item, or device is covered by any warranty not mandated by this Act.

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APPENDIX D
CALIFORNIA AIR RESOURCES BOARD STATEMENT OF ADOPTION OF EPA NONROAD DIESEL ENGINE FINAL RULE

ARB Adopts Federal Standards Applicable to Off-Road Diesel Engines -- On January 28, 2000, California's Air Resources Board adopted the federal Tier 2 and Tier 3 standards applicable to diesel-powered off-road (nonroad) engines. The standards are shown in Table 1. The federal standards, adopted in October 1998, and the proposed ARB standards are based on an August 1996 Statement of Principals (SOP) signed by the manufacturers of off-road diesel engines, the U.S. EPA, and ARB. The standards are not expected to require the use of exhaust control technology.

ARB also adopted the federal voluntary "Blue Sky Series" standards adopted by the U.S. EPA. These standards are applicable through the 2004 model year and are based on the Tier 3 standards, where applicable, and a 40 percent reduction from Tier 2 levels for PM standards where no Tier 3 PM standard has been established. At the hearing, several Board members indicated that further emission reductions from off-road engines will be needed to help California meet its air quality objectives.

Table 1

Proposed California Emission Standards for Off-Road Compression-Ignition Engines [a] (grams per kilowatt-hour)

Maximum Rated Power (kW)	Tier	Model Year	NOx	HC	NMHC+NOx[e]	CO	PM
KW<8[b]	Tier 1	2000-2004	—	—	10.5	8.0	1.0
	Tier 2	2005 and later	—	—	7.5	8.0	0.80
8≤kW<19 [b]	Tier 1	2000-2004	—	—	9.5	6.6	0.80
	Tier 2	2005 and later	—	—	7.5	6.6	0.80
19≤kW<37	Tier 1	2000-2003	—	—	9.5	5.5	0.80
	Tier 2	2004 and later	—	—	7.5	5.5	0.60
37≤kW<75	Tier 1	2000-2003	9.2	—	—	—	—
	Tier 2	2004-2007	—	—	7.5	5.0	0.40
	Tier 3	2008 and later	—	—	4.7	5.0	—
75≤kW<130	Tier 1	2000-2002	9.2	—	—	—	—
	Tier 2	2003-2006	—	—	6.6	5.0	0.30
	Tier 3	2007 and later	—	—	4.0	5.0	—
130≤kW<225	Tier 1[c]	1996-2002	9.2	1.3	—	11.4	0.54
	Tier 2[d]	2003-2005	—	—	6.6	3.5	0.20
	Tier 3	2006 and later	—	—	4.0	3.5	—
225≤kW<450	Tier 1 [c]	1996-2000	9.2	1.3	—	11.4	0.54
	Tier 2[d]	2001-2005	—	—	6.4	3.5	0.20
	Tier 3	2006 and later	—	—	4.0	3.5	—
450≤kW≤560	Tier 1 [c]	1996-2001	9.2	1.3	—	11.4	0.54
	Tier 2 [d]	2002-2005	—	—	6.4	3.5	0.20
	Tier 3	2006 and later	—	—	4.0	3.5	—
kW>560	Tier 1 [d]	2000-2005	9.2	1.3	—	11.4	0.54
	Tier 2	2006 and later	—	—	6.4	3.5	0.20

Notes:

a. The proposed California standards for engines less than 130 kilowatts (175 horsepower) apply only to non-preempted equipment.

b. The Tier 1 and Tier 2 emission standards for less than 25 horsepower compression-ignition engines were already adopted in the small off-road engine rulemaking.

c. The Tier 1 emission standards were already adopted for 1996 and later engines. This proposal will modify the existing standards for 2000 and later engines, replacing them with the noted Tier 2 and Tier 3 standards.

d. The Tier 1 emission standards were already adopted for 2000 and later engines.

e. NMHC + NOx = non-methane hydrocarbons plus oxides of nitrogen